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An Analysis of Canadian Demand for Imported Tomatoes: One Market or Many?

by

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and
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Introduction

Technological advances in production and distribution of U.S. and Mexican tomatoes, have enabled Canadians to purchase imported fresh tomatoes at reasonable prices throughout the year. As a result, tomatoes have become a staple part of the national diet and lead all fresh fruit and vegetable imports in terms of volume and value. In 1985, fresh tomato imports exceeded 305 million pounds for a total value of C$107 million. Over 85 percent of these imports were supplied by the United States, while the balance were supplied mainly by Mexico.

During the spring, summer and fall seasons imported tomatoes compete with Canadian greenhouse and field tomato production. As imports have become more affordable, domestic production has declined and the government has increased its level of protection. In an attempt to balance the needs of consumers and farmers, however, the Government of Canada has developed a seasonal tariff system which is unique to the horticultural industry. During the designated "off-season" imported tomatoes enter duty-free, while during the remainder of the year, they are assessed import tariffs which are now amongst the highest paid on any goods.

Despite the high level of protection, commercial production of fresh table tomatoes in Canada seldom exceeds the volume of imports. The exceptions are in those regions of the Canada where commercial production is concentrated. Although tomatoes can be grown in backyard gardens in most parts of the country, the short summer season precludes commercial field production of fresh tomatoes, except in the southern parts of Ontario and Quebec. Greenhouse tomato production is even more concentrated. Over 90 percent of all greenhouse tomatoes are produced in one county of southwestern Ontario, while most of the balance are grown near Vancouver, British Columbia.

In recognition of the regional characteristics of the fresh tomato market, the country is divided into three geographic tariff regions, and the seasonal tariff is varied by region. The seasonal tariff, which may be applied for up to 32 weeks, usually starts at the end of April in eastern Canada, but may last until late November in western Canada. These beginning and ending dates coincide with the production of greenhouse tomatoes. Field tomatoes are seldom available until mid-June, and are off the market by the end of September.

The competitive position of imported fresh tomatoes has changed significantly in recent years. Florida tomato producers adopted major technological innovations in the mid-1970s which generated a substantial shift in the U.S. supply (Bredahl et al.). As a result, Florida producers increased their share of the Canadian market and became the dominant supplier. Since 1976, however, the Canadian dollar has depreciated over 30 percent vis a vis the U.S. dollar, making imported supplies more expensive for Canadian consumers. Moreover, the Canadian import tariffs on fresh tomatoes were increased in 1980, from 10 to 15 percent (ad valorem). Despite this increased protection, there is negligible inter-regional trade of fresh tomatoes outside of eastern Canada.

The economic rationale for protecting the domestic tomato industry is questionable for large parts of Canada. For example, consumers in the prairie provinces pay import tariffs for half the year, but have no local commercial production and receive minimal volumes of domestic tomatoes from other parts of the country. Similarly, a tariff is collected in all parts of the country during spring and fall periods of the year when the limited supplies of domestic greenhouse tomatoes are available only at local markets.

Even in those parts of the country which do have significant local production, the effectiveness of the higher tariff is not apparent. Contrary to the predictions of Hammig and Mittelhammer, the production of Canadian table tomatoes has not increased since the major increase in the import tariff.

This paper reports the results of an econometric analysis the fresh tomato import demand in Canada, on a regional basis, for the period 1977-1985. The objectives of the study were:

1. to determine whether the tomato market is one or many.
2. to estimate the demand for imported tomatoes on four regional markets to determine whether Canadian demand characteristics are consistent across the country;
3. to evaluate the impacts of the 1980 increase in the seasonal import tariffs; and,
4. to estimate the impacts of the devaluation of the Canadian dollar on the demand for imported tomatoes.

Preliminary Analyses of Tomato Price Data

In this section, some preliminary analyses on the price series are presented to examine the issue of market definition. The purpose is to use simple graphical and statistical concepts to compare tomato prices over the sample period. The price series used in this and the following sections are monthly and cover the period January 1977 to December 1985. For purposes of consistency, only prices of medium size (6 x 7) grade imported tomatoes were collected. This is the largest single grade of imported tomtoes. Moreover, it is the only grade which is available on all major Canadian markets on a year-round basis. The tomato prices pertain to the following four Canadian markets: a) Montreal, b) Toronto, c) Winnipeg and d) Vancouver. The price series for the four Canadian markets are wholesale prices while the U.S. price, where used, is the monthly f.o.b. shipping point price.

In Appendix A are presented the graphical representations of price levels and differentials for the Canadian and U.S. series. Figure A1 in the Appendix shows plots of Toronto, Montreal and U.S. f.o.b. tomato price levels over the sample period. Figure A2, on the other hand, shows similar plots for Winnipeg, Vancouver and the U.S. price levels. The striking feature about these plots is that they all show the same trend over the sample period. The extreme fluctuations in the price levels seem to have started in 1981. The means, variance and coefficients of variation on a yearly basis and for the full sample periods are summarized in Tables B1 and B2 in Appendix B.

The extreme variability in the Canadian tomato prices summarized by c.v.'s in Table B2 coincide with the variability in the U.S. f.o.b. price. The variability in U.S. tomato f.o.b. prices over the years has been transmitted to the Canadian wholsale prices of tomatoes. The full effect of this transmission mechanism will be examined later on.

Figures A3 and A4 plot the pairwise price differentials for the four Canadian cities. The fluctuations in price differentials for all city prices intensify after 1981. With the exception of the Montreal-Toronto and Winnipeg-Vancouver price differentials which are positive for the entire sample period, the rest are consistently negative.

Over the long-run, if prices are in the same market, the price differentials should equal zero: that is the differential in prices should fluctuate randomly around zero. Since the graphical plots of the price differentials are bunched together, a t-test was used to test the hypothesis that the mean price differentials are zero on a yearly basis and also for the full sample period.

In Table B3 of Appendix B, the results of the hypothesis that the mean price differentials for any pair of cities is zero are reported. The results based on a t-test indicate that at the 5 percent level, the null hypothesis of zero price differential could be accepted in only 17 out of 54 cases. For the sample period, as a whole, the null hypothesis of a zero price differential could only be accepted in the case of the Winnipeg-Vancouver city-pair.

Figures A5 and A6 in Appendix A also depict the plots of the differentials between the j-th Canadian city and the U.S. f.o.b. tomato prices. As expected, the price differentials between each Canadian city and U.S. f.o.b. prices are all positive with the exception of one month in each case. Thus from the plots in Figures A5 and A6, a test of whether the mean price differential between the j-th Canadian city and U.S. f.o.b. price equals zero should be rejected.

Table B4 in the appendix reports the results of the test of the hypothesis that the mean price differential between a Canadian city and the U.S. f.o.b. price is equal to zero. The null hypothesis of no price differences is rejected for the within year as well as for the full sample results in all cases. This suggests a picture of the Canadian tomato market which is less like a single entity and more like the tips of fingers which are emanating from a very large hand.

What is a Market?

A good survey of alternative definitions of a market and the statistical aspects are to be found in Uri et al. (1985). Since the original regression approach was proposed by Horowitz (1981) and generalized by Uri et al. (1985), an abridged version of the concepts based on Uri et al.'s study are presented in this section to facilitate reference to the equations that are estimated and discussed.

To adequately address this issue, we first need to define what a market is. Some definitions are:

(1) Cournot (1838)

- A market is the entire territory of which parts are so united by the relations of unrestricted commerce that prices there take the same level throughout with ease and rapidity.

(2) Cochrane (1957), JFE pp. 21-22)

- A market is some sphere or space where:

(i) the forces of demand and supply are at work;

(ii) to determine or modify price

(iii) as the ownership of some quantity of a good or service is transferred, and

(iv) certain physical and institutional arrangements may be in evidence.

(3) Penguin Dictionary of Economics (Bannock, Baxter and Rees, 2nd Edition, 1981, p. 297) states that:

- a market is defined in terms of the fundamental forces of Supply and Demand, and is not necessarily confined to any particular geographic location.

(4) Bressler and King (1970, pp.74-75) state that:

- A market may be loosely defined as an area or setting within which producers and consumers are in communication with one another, where supply and demand conditions operate...

Is the price determination process among regions interdependent in a common market? Popular wisdom tends to associate common markets with a unique price. If markets do overlap, shocks in supply and demand in one market may cause price changes in the other markets even in the absence of actual product movements between regions.

Statistical Procedures on Market Definition

Given time series data on prices, how can one use the series to define one or many geographic markets? Some of the common statistical procedures normally encountered in the literature are:

1. Simple Correlation Analysis

High correlation between prices of a homogeneous commodity in different markets has been taken to be an indication that these markets form one common market. There are some disadvantages of this approach, namely:

a) How high should the correlation coefficient be?

b) Spurious correlation among prices in different markets could be due to underlying inflationary trends or other factors assumed to be constant when in fact this is not the case.

A suggested remedy of dealing with the problem of spuriousness is to purge the price series of inflationary trends using either first differences or the logarithms of prices.

In the context of the tomato study, the correlations obtained between the four regional markets based on price levels are presented in the upper part of Table 1. The highest correlation (ρ) of .964 is between Montreal and Toronto, with the lowest of .823 between Montreal and Vancouver. With all ρ_{ik} over .80, and significant at 5 percent, are we to interpret the results as indicative of one national tomato/geographic market? The only discernible feature of these data is that the correlations become relatively smaller as the distance between the cities increases.

In the lower triangular part of Table 1 is reported the correlations among the first differences of the four price series. The highest correlation still exists between Montreal and Toronto. However, the ranking of cities based on the correlations of first differences of the price series remain the same. These correlations

Table 1

Correlations Among City Prices[a, b, c]

Montreal	Toronto	Winnipeg	Vancouver
1.000	0.964	0.915	0.823
	(0.0001)	(0.0001)	(0.0001)
0.941	1.000	0.920	0.839
(0.0001)		(0.0001)	(0.0001)
0.824	0.895	1.000	0.838
(0.0001)	(0.0001)	(0.0001)	(0.0001)
0.671	0.718	0.776	1.000
(0.0001)	(0.0001)	(0.0001)	

a) the terms in parentheses are the Pearson correlation coefficients (Prob > $|\rho|$ under H_0: $\rho = 0$

b) the upper triangular matrix refers to correlations among price levels whereas the lower matrix refers to correlations among first differences of prices.

c) number of observations are 108 and 107 for the upper and lower matrices respectively.

are lower than the previous ones as expected. Such correlations, however, do not provide convincing evidence that a single national tomato market exists.

2. The Horowitz Procedure

Horowitz (1981), proposed a regression based methodology to identify geographic markets using product prices. Following Horowitz, the price differential between any pair of cities i and j in any time period, t is:

$$(1)\quad D_{ijt} = P_{it} - P_{jt}$$

He assumes that over time, price differentials will gravitate toward the unobserved long-run price differential by positing the following adjustment mechanism:

$$(2)\quad DL_{ijt} - D_{ijt} = \beta_1 (DL_{ijt} - D_{ijt-1})$$

where DL_{ijt} is the long-run price differential between any pair of markets and $\beta_1 \in (-1, 1)$ is the adjustment parameter. Also, he assumes that the long-run price differential takes the form:

$$(3)\quad DL_{ijt} = a_{ijt} + U_t^*$$

On substituting (3) into (2) and re-arranging terms we have:

$$(4)\quad D_{ijt} = (1 - \beta_1)a_{ijt} + \beta_1 D_{ijt-1} + \tilde{U}_t$$

where $\tilde{U}_t = (1 - \beta_1)\, U_t^*$

On reparameterization, (4) can be estimated via OLS as:

$$(4') \quad D_{ijt} = a_0 + \beta'_1 D_{ijt-1} + \tilde{U}_t$$

Failure to reject the null hypothesis that $\beta'_1 = 0$ for any pair of cities implies that the price data from these cities are part of the same market (Uri et al. p. 902). However, it should be noted that β_1 does not tell us anything about the rate at which price differences approach equilibrium.

In the long-run we expect the price differential between any two cities to equal zero (i.e., $P_{it} - P_{jt} = 0$). It should, therefore, be possible to examine the long-run relationship between prices using relative prices. The price in the i-th city relative to that in the j-th city, in the long run should equal unity; i.e.:

$$P_{it} / P_{jt} = 1 \quad \text{or} \quad P_{it} - P_{jt} = 0$$

A regression equation to test the proposition that in the long run, relative prices equal unity is given by:

$$(5) \qquad \left(\frac{\text{Price in city i}}{\text{Price in city j}} \right)_t = \delta_0 + \delta_1 Z_1 + u_t$$

where Z_t is a time-trend variable with $Z_1 = 1, 2, \ldots 108$. A joint test of the long-run tendency of relative prices toward unity is H_0: $\delta_0 = 1$, $\delta_1 = 0$ and H_A: $\delta_0 \neq 1$, $\delta_1 \neq 0$. If the null hypothesis is accepted, it implies that there is one price among cities in the long run.

3. Modified Horowitz Procedure

Price dynamics has been introduced into the Horowitz formulation by Uri et al. (1985). They assume that the price dynamics in market i takes the form:

(6) $P_{it} = a_{10} + b_1^* P_{it-1} + u_{it} \qquad |b_1^*| < 1$

and for market j;

(7) $P_{jt} = a_{j0} + u_{jt}$

Premultiplying (7) by b_1^*, lagging and subtracting from itself:

(8) $P_{jt} - b_1^* P_{jt-1} = a_{j0}(1-b_1^*) + u_{jt} - b_1 u_{jt-1}$

Equation (8) thus results in an ARIMA(1,0,1) process for market j. On subtracting (8) from (6) yields the price differentials between markets:

(9) $D_{ijt} = a_0^* + b_1^* D_{ijt-1} + U_{it} - U_{jt} + b_1^* U_{jt-1}$

where the composite error term in (9) is rewritten as:

$$U_{it} - U_{jt} + b_1^* U_{jt-1} = \epsilon_t - \delta\epsilon_{t-1}$$

Thus equation (9) becomes:

(10) $D_{ijt} = a_0^* + b_1 D_{ijt-1} + \epsilon_t - \delta\epsilon_{t-1}$

which is an ARIMA(1,0,1) process for price differentials between any pair of cities.

4. Common Exogenous Factor Model

In the presence of a common exogenous variable in all the markets, prices in each market can be written as a function of this common factor:

$$(11a) \quad P_{it} = a_i^{**} + b_i^{**} Y_t + U_{it}^{**}$$

$$(11b) \quad P_{jt} = a_j^{**} + b_j^{**} Y_t + U_{jt}^{**}$$

where for example Y_t can be either the U.S. f.o.b. price for tomatoes or the Canadian/U.S. dollar exchange rate.

Two cities can be deemed to be in the same geographic market if in equation (11) $b_i^{**} = b_j^{**}$.

On combining (11a) and (11b) under the assumption that the two markets are the same, we obtain:

$$(11') \quad P_{it} - P_{jt} = (a_i^{**} - a_j^{**}) + (b_i^{**} - b_j^{**}) Y_t + U_{it}^{**} - U_{jt}^{**}$$

Equations 11a and 11b are estimated jointly and the equality between b_i^{**} and b_j^{**} is tested to determine if in fact a common market exists.

5. Multivariate Test

Another statistical procedure used in testing the one market or many is based on a multivariate version of "Granger" causality. Under this procedure, causal inferences are based on F-statistics which are used to test the joint significance of particular lags associated with the independent variables in the estimated equations. In implementing the Granger test, the issues of spurious correlation and choice of lag length have to be addressed. The choice of lag length is normally selected on the basis of Akaike's Information Criteria (AIC). The issue of spurious correlation is usually overcome by prefiltering the data. In this study, however, the price series are not prefiltered. A time trend variable is included in the equation to pick up any spuriousness in the data.

The autoregressive model used is:

$$12) \qquad Y_{(t)} = \sum_{i=1}^{P} \begin{bmatrix} b_{i11} & \cdots & b_{i1n} \\ b_{in1} & \cdots & b_{inn} \end{bmatrix} Y_{(t-i)} + cTime + dEXRATE_t + U_t$$

where Y is a 4 x 4 vector of observed prices, P is the order of the autoregression, b_{ijk} are the autoregressive parameters, Time is a trend variable, EXRATE is the Canadian/U.S. dollar exchange rate and U_t is a vector of error terms which is assumed to be white noise. Equation (12) also include eleven monthly dummies to account to seasonality in the price series. The statistical procedure outlined is also used in some context to test for market efficiency. In this paper, the view taken is that if the hypothesis that prices in city j do not "cause" prices in city i in the Granger sense, then the markets are separate. On the other hand, if prices in city j cause prices in city i, then the markets are part of a common geographic entity. In other words, if "Granger" causality is accepted for any pair of cities, then the price discovery process in city i is enhanced by prices in city j if city j's prices "cause" city i's prices.

6. Spatial Market Integration Test

The final statistical procedure that is used in identifying markets is based on the concept of market integration. This approach based on spatial price differentials has been proposed by Ravallion (1986). The statistical testing of integration as argued by Ravallion (1986) overcomes the dangers inherent in using spatial price correlations.

Ravallion's statistical methodology is adopted here to test the spatial integration of the tomato market in Canada. If integration in the tomato market is accepted, we will interprete it to mean the existence of one market in the long run. On the other hand, this methodology can also be used to test other hypotheses, namely: a) market segmentation, b) short-run market integration, and c) long-run market integration. As noted earlier, if the hypothesis of long-run market integration is accepted to mean the existence of one market, the acceptance of the segmentation hypothesis will imply the existence of many markets.

The equation used in testing the three hypotheses above is Ravallion's (1986, p.104) equation 4:

$$(13) \qquad P_{it} = \sum_{j=1}^{n} a_{ij} P_{it-j} + \sum_{j=0}^{n} b_{ij} P_{1t-j} + c_i X_{it} + e_{it}$$

$(i = 2, \ldots N)$

where N=4 in this study, a's, b's are fixed coefficients, e_{it}'s are error processes and P_{it} is the tomato price in the i^{th} city. The variable P_{1t} is the price of tomatoes in a central market.

The hypothesis of market segmentation implies that the prices in the central market P_{1t-j} (j=0,...J) do not influence prices in the other markets. This hypothesis is tested by imposing the restrictions that $b_{ij} = 0$ for j=0,...,J. If price increases in the central market are immediately passed on to the other markets, then there is the existence of a short-run market integration. The test for this is: $b_i = 1$, $a_{ij} = b_{ij} = 0$ (j=1,...,J). In the long run, prices in all markets are assumed to be constant over time. Long-run market integration is tested by imposing the restriction:

$$\sum_{j=1}^{n} a_{ij} + \sum_{j=0}^{n} b_{ij} = 1$$

One appealing feature of the spatial integration testing is that if the four markets under consideration are integrated, then an aggregate analysis of the tomato market can be performed in the second part of this study (Monke and Petzel, 1984, p. 482).

Statistical Results on One Market or Many

From the definitions of a market noted earlier, we know from theory that a market is a sphere of commercial activities. Within such a sphere, the prices of a homogeneous commodity at different locations should, in the absence of transportation costs, tend to uniformity. The statistical procedures mentioned are now empirically evaluated to shed some light on whether we have one national or regionally segmented tomato markets.

The data used for the empirical evaluation of the aforementioned procedures are the observed monthly wholesale tomato prices in four cities in Canada. The cities are Montreal (M), Toronto (T), Winnipeg (W), and Vancouver (V). On a regional classification basis, the first two cities are located in central Canada whereas the latter two are in western Canada. In terms of distance, Winnipeg is epicentre of Montreal and Vancouver and also with Toronto closer in proximity to Montreal than any other city. The sample period of analysis is from January 1977 to December 1985 with a total of 108 observations per city. The other variables used in the analysis in addition to the wholesale prices are monthly Canadian/U.S. dollar exchange rate (EXRATE), the U.S. f.o.b. tomato price (USB), and a time trend.

The empirical results from the Horowitz procedure corrected for serial correlation, equation (4') are presented in Table 2. The stability condition that $|\beta_1| < 1$ is satisfied in all instances. Since $\beta_1 \neq 0$ and $|\beta_1| \leq 1$ is satisfied in all city pairs except in Montreal-Vancouver and Toronto-Vancouver, the long run equilibrium in Horowitz's context is being approached in four out of six city pairwise configurations. It should also be noted that by Horowitz's criteria if $|\beta_1| < 1$ we can conclude that tomato prices in the four cities are generated by the same market. The anomaly in these results is that since $\beta_1 = 0$ for Montreal-Vancouver and Toronto-Vancouver, it implies that the long-run equilibrium in these markets has been

Table 2

Results for Equation 4':

$$D_{ijt} = a_0 + \beta'_1 D_{ijt-1} + U_t^{a)}$$

Cities[b]	a_0	β'_1	R^2	SE	DW
M-T	0.006 (.548)	0.3759 (3.937)[c]	0.1205	.0354	2.111
M-W	-0.0573 (2.721)	0.3130 (3.220)	.0827	.0619	2.083
M-V	-0.1329 (5.337)	0.1685 (1.658)	.2072	.0733	1.992
T-W	-0.0421 (2.214)	0.60833 (7.544)	.3393	.0534	2.155
T-V	-0.1505 (6.231)	0.1350 (1.326)	.2066	.0676	1.962
W-V	-0.0684 (2.675)	0.4730 (5.172)	.2374	.0767	2.025

a) All regressions include monthly dummies but were not reported.

b) M = Montreal, T=Toronto, W=Winnipeg, V=Vancouver.

c) Absolute t-values in parentheses.

achieved. The β_1 estimate for the other city pairs indicate that the long-run equilibrium is not yet achieved in these cities.

The results of the relative price equation (5) are reported in Table 3. The null hypothesis of the long-run constancy of one price based on a F-test was rejected in all cases. The marginal significance level of the F-statistics was found to be 0.001 for each elative price. Thus, the hypothesis of one price does not hold in the long run among any of the relative price ratios.

The results of the modified Horowitz procedure based on equation (10) state that the price differential between any two city pairs can be modeled as an ARIMA process. The estimated results for the best ARIMA models obtained for the price differentials are shown in Table 4. From the reported results, only two city pairs, Montreal-Toronto and Montreal-Vancouver, could successfully be modeled as ARIMA (1,0,1) processes. Winnipeg-Vancouver, on the other hand, could be modeled as an AR(1) process. Even with these two processes, if the usual stationarity and invertibility conditions are applied, the result for Montreal-Vancouver comes close to a random walk. Overall, the conclusion here is that the city price differentials could not be modeled as ARIMA (1,0,1).

The results of a common exogenous factor approach are reported in Tables 5 and 6. The OLS estimates of equation (11') are reported in Table 5. Table 6, on the other hand, reports the F-statistic for the joint test that b_i^* and b_j^{**} in equations (11a) and (11b) respectively are equal. Two common exogenous factors were tried separately in testing for the equality of b_i^{**} and b_j^{**}. The common factors chosen

Table 3

Relative Tomato Prices of City I with Respect to City J[a, b, c)]

	T	M	W	V
T	-	0.9980(35.206) 0.0010(4.512)	1.0940(26.611) 0.0027(8.007)	1.4705(26.004) -0.0005(0.999)
M	1.0016(40.197) -0.0009(4.684)	-	1.0906(24.251) 0.0016(4.261)	1.4518(25.813) -0.0015(3.338)
W	0.9319(28.353) -0.0021(7.950)	0.9271(26.372) -0.0012(4.353)	-	1.3386(26.003) -0.0028(6.669)
V	0.6722(16.197) 0.0005(1.553)	0.6562(14.136) 0.0015(3.909)	0.7087(14.854) 0.0029(7.692)	-

a) All regressions included monthly dummies.

b) The first row reports the estimate of a and the second row is the estimate of b. Absolute t-values are shown parenthetically.

c) T=Toronto, M=Montreal, W=Winnipeg and V=Vancouver.

Table 4

Results based on Equation (10)

DPMT:[a] $(1 - \underset{(11.89)^{b}}{.9154}L)DPMT = \underset{(2.38)}{0.2218} + (1 - \underset{(5.90)}{.7402}L)\ \epsilon_t$

DPMW: $(1 - L)DPMW = (1 - \underset{(15.75)}{.83703}L)\ \epsilon_t$

or

DPMW: $(1 + \underset{(1.79}{.3382}L - \underset{(3.24)}{.4387}L^2 - \underset{(5.31)}{.8995}\ L^3)\ DPMW =$

$(1 + \underset{(2.15)}{.463}L - \underset{(2.20)}{.3596}L^2 - \underset{(4.10)}{.7784}L^3)\epsilon_t$

DPMV: $(1 - \underset{(39.29)}{.98358}L)DPMV = (1 - \underset{(13.79)}{.8943}L)\ \epsilon_t$

DPTW: $(1 - \underset{(9.5)}{1.29982}L + \underset{(2.26)}{.2998}L^2)\ DPTW = (1 - \underset{(8.95)}{.8813}L)\ \epsilon_t$

DPTV: $DPTV = (1 - \underset{(7.86)}{.7648}L - \underset{(2.85)}{.3494}L^2 + \underset{(1.81)}{.1836}L^3)\ \epsilon_t$

DPWV: $(1 - \underset{(5.21)}{.45021}L)\ DPWV = \epsilon_t$

a) Prefix DP is price differential for example DPMV is the differential in Montreal-Vancouver prices and L is the backword shift operator.

b) Absolute t - values in parentheses.

<u>Note</u>: The results reported above are the best ARIMA (p. 9) models for price differentials without strict adherence to whether stationarity and invertibility conditions in such models are met.

Table 5

Results for (11′) $D_{ijt} = a_0 + B_1 Y_t + E_t$

	a_0	B_1	$\bar{R}^2$	SE	DW
M-T[c]	-0.1444 (2.926)	0.1735 (3.231)	0.116	0.0338	2.028
M-W	0.2355 (2.732)	-0.2888 (3.574)	0.126	0.0589	2.000
M-V	-0.3574 (3.410)	0.2077 (1.181)	0.233	0.0716	1.984
T-W	0.2898 (3.967)	-0.4394 (4.975)	0.1960	0.0501	1.969
T-V	-0.190 (1.922)	0.0371 (0.409)	0.192	1.9610	1.720
W-V	0.5079 (4.839)	0.4921 (4.296)	0.191	0.0719	1.927

a)Absolute t-values in parentheses.
b)The exogenous factor used is the Canadian-US exchange rate.
c)The city pair variables refer to the first letter in each city name: M=Montreal, T=Toronto, W=Winnipeg, and V=Vancouver

Table 6

F - Test Based on Equations (11a) and (11b)[a]

	USFOB[b]	EXRATE[b]
M-Tc	10.256 (0.0016)[d]	17.553 (0.0001)
M-W	5.184 (0.0239)	20.946 (0.0001)
M-V	4.555 (0.0341)	5.032 (0.0260)
T-W	17.231 (0.0001)	61.704 (0.0001)
T-V	0.325 (0.5691)	0.530 (0.8190)
W-V	13.722 (0.0003)	34.088 (0.0001)

a)Under joint estimation, using SURE, the F-test has asymptotic properties.

b)USFOB and EXRATE are the U.S. f.o.b. price of tomatoes and the Canadian- U.S. dollar exchange rate respectively.

c)See note c of Table 5 on abbreviations used for city pairs.

d)Figures in parentheses are marginal significance levels.

were the Canadian/U.S. dollar exchange rate and the U.S. f.o.b. price for tomatoes. The reported F-statistics in Table 6 show that irrespective of the common factor used, the equality between b_i^{**} and b_j^{**} in (11a) and (11b) is rejected in five out of the six city pairs. Equality between b_i^{**} and b_j^{**} could not be rejected for the Toronto-Vancouver city pair. It is interesting to note that even though Toronto-Vancouver could not be modelled as an ARRIMA(1,0,1) process under the previous procedure and thus not constitute a common market, the joint test for equality selects this city pair as constituting one market.

The results of the multivariate model (12) are presented in Table 7. The order of the AR process was identified using the information criteria (AIC). In all four city prices, the AIC selected an AR(1) model. The implication is that there is no contemporaneous relationship between the city prices from the chosen AR process. The contemporaneous relationship between the city price, however, is summarized in Table 8 using the residuals from the vector AR model in equation (12). In Table 7, the reported F-statistics refer to the hypothesis that the lag of a variable in the left hand column has zero coefficients in the equations at the top of the table. The reported values in parentheses in this table are the marginal significance levels for the test statistic. The test results show that lagged Toronto prices (NIPTL) have a significant impact on all markets. The impact of lagged Toronto prices on the other markets were all positive and large, ranging from 0.828 for Montreal and 1.135, 1.052 and 1.240 for Toronto, Winnipeg and Vancouver respectively. This seems to

Table 7

Results of F-Test for Multivariate Autoregressive Models for Montreal, Toronto, Winnipeg and Vancouver Tomato Prices[a)]

Lag[b]	Montreal	Toronto	Winnipeg	Vancouver
ML	0.1584 (0.6916)[c]	0.0782 (0.7804)	0.0079 (0.9292)	0.3588 (0.5507)
TL	4.7306 (0.0323)	9.7890 (0.0024)	6.7680 (0.0109)	9.4855 (0.0027)
WL	3.7268 (0.0567)	6.3319 (0.0136)	1.4369 (0.2328)	6.3266 (0.0137)
VL	0.3244 (0.5704)	0.7341 (0.3938)	1.5269 (0.2198)	0.0617 (0.8044)

[a)]Marginal significance levels of F-Statistics in parentheses.

[b)]In this column, ML, TL, WL and VL are the one period lag of Montreal, Toronto, Winnipeg and Vancouver respectively.

[c)]The multivariate regressions included the Canadian/U.S. dollar exchange rate and eleven monthly dummies.

suggest that the prices in the other cities follow the price in Toronto. The Winnipeg price also has an impact on prices in Toronto and Vancouver. However, the impact of Winnipeg prices on these two cities were negative, with a value of -0.520 and -0.577 for Toronto and Vancouver respectively. The prices in Montreal and Vancouver had no impact on the other regional prices.

The residual correlations in Table 8 summarizes the system contemporaneous relationships among the regional prices. The correlations show that the farther away from Toronto you get, the lower the correlations become. Thus, distance appears to be a factor in the price discovery process. An interesting point to note is that the correlation between Winnipeg and Vancouver is lower than that between Toronto and Vancouver even though, in terms of regional classification, Winnipeg and Vancouver are both in western Canada. In summary, it appears from the multivariate analysis that Toronto seems to be the dominant market in the price discovery process.

In the estimation of equation (13), P_{1t} (Toronto prices as the central market) was replaced by its predicted values ($\hat{P}_{1t}$) from a reduced form equation to avoid the problem of simultaneity (Ravallion, p. 106). The reduced form estimates of P_{1t} are obtained by regressing P_{1t} on its lagged values, lagged values of prices in the other cities, eleven monthly dummies and a time trend variable. Using the predicted values of P_{1t} as instruments, the least squares estimator was then applied to equation (13).

The test results of the spatial market integration are reported in Table 9. In addition to the three hypotheses of market segmentation,

Table 8

Correlation Matrix of Residuals
of Multivariate AR Model[a)]

Montreal	Toronto	Winnipeg	Vancouver
1.0000	0.9436 (0.0001)	0.8554 (0.0001)	0.7530 (0.0001)
	1.0000	0.9128 (0.0001)	0.7762 (0.0001)
		1.0000	0.7692 (0.0001)
			1.0000

[a)]Marginal significance levels for the residual correlations in parentheses.

Table 9

Tests for Spatial Integration with Toronto as the Central Market[a)]

	Montreal	Winnipeg	Vancouver
1. Market segmentation	3.6343 (0.0053)[a]	6.4797 (0.0001)	8.0130 (0.0001)
2. Short-run integration	0.2525 (0.9841)	1.0049 (0.4435)	2.2408 (0.0274)
3. Long-run integration	0.1490 (0.9031)	0.0831 (0.7739)	10.2578 (0.0020)
4. Local tariff effect	1.0145 (0.3169)	0.0089 (0.9251)	0.9180 (0.3409)
5. Local trend effect	0.0760 (0.7835)	3.0761 (0.0833)	3.3163 (0.0723)
6. Local seasonality effect	0.2149 (0.9957	0.2668 (0.9896)	1.3530 (0.2114)

[a)]The marginal significance levels for the F-tests are shown parenthetically.

Note: The degreres of freedom for rows (1), (2), (3) are F(5,80), F(9,80) and F(1,80) respectively. Rows (4) and (5) are F(1,80) and row (6) is distributed as F(11,80).

short-run and long-run integration, tests on three other non-price variables were conducted. These tests are a) local tariff effect, b) local trend effect and c) local seasonality effect. The tariff effect is proxied by a dummy variable. This variable takes on a value of unity in the months in which a tariff is imposed on imported tomatoes and zero otherwise. The trend effect is captured by a simple time trend variable. The seasonality effect on the other hand is captured by the inclusion of twelve monthly dummies in each of three equations.

The reported results in Table 9 show that there is no evidence of local tariff nor seasonality effects in any of the three markets. However, there is evidence of local trend effects in two of the three markets. The hypothesis of market segmentation is rejected in all three markets. This implies that the central market (Toronto) prices influence prices in the other three markets. Incidentally, this test supports the earlier based on the multivariate test in which Toronto prices were found to have a dominant influence on prices in the other markets. The hypotheses on both short-run and long-run integration are supported by two out of three markets. In each case, the hypotheses are rejected in the Vancouver market.

One may question the choice of Toronto as the central market since there is no a priori information to indicate it is. In an ideal situation, a central market is preferably one that is a residual supplier to the other remaining markets or linked to them by a mono-centric transportation network. If we have a radial market configuration, then choosing a central market as the starting point is easy. However, since the tomato market cannot be classified as one with a radial configuration. The above hypotheses are tested again by assuming that each market is a potential central market.

The test results with Montreal, Winnipeg and Vancouver with each as the central market are reported in Table C1-C3 in Appendix C respectively. The summary of the results in Appendix C is that irrespective of the choice of a central market, the market segmentation hypothesis is rejected in all cases. The striking feature of the model with Vancouver as the central market is that the market segmentation, short-run and long-run integration are rejected in the other three markets.

The conflicting results from the spatial integration testing is not unexpected. The power of the test is not in doubt. However, since a critical assumption of either a radial market configuration or one market being a residual supplier to the others is not justifiable in the case of Canada. The above results should be interpreted with caution. In this study, the residual supplier (i.e., central market) lies outside of Canada (i.e., U.S.). A topic outside the scope of this study will be to examine whether the U.S. tomato market is indeed a residual supplier to Canadian markets.

<u>Summary of One or Many Markets for Tomatoes</u>

The results of the statistical analyses are inconclusive in answering the question of whether we have one or many tomato markets.

On the basis of the Horowitz procedure alone, the results indicate that we have one geographic tomato market for Canada. However, the extensions of the Horowitz procedure do not support this contention. The results of the multivariate analysis based on the concept of "Granger" causality did not provide a definitive answer to the one or many markets question. It does indicate that the Toronto market prices dominate the price discovery process in the other cities. Thus, in a sense, the Toronto prices could be taken as the national price for wholesale tomato prices in Canada. The issue of whether tomato prices in Toronto could be taken as the national price would merit further study before a definite conclusion can be reached.

The results from the spatial integration testing is also inconclusive since a definitive central market could not be identified in Canada.

The transportation network in Canada is not monocentric to allow trade in tomatoes between the four markets under study. It is also possible that provincial barriers to trade in tomatoes if any exist could result in the kind of results obtained thus far.

The rest of the study will focus on the import demand for U.S. tomatoes in Canada. Since the issue of one or many markets could not be satisfactorily resolved, the econometric model we adopt for the import study will accommodate regional difference in prices. This can be accomplished by introducing city dummy variables into a price linkage equation. The significance of these dummy variables should thus indicate the importance of these variables in the analysis to follow.

There is no page 32

PART II: CANADA-U.S. TOMATO TRADE

Introduction

During the past twenty-five years, Canadians have become increasingly concerned about the health effects of diet. As a result, the proportion of red meats and fats in the diet has declined, while the consumption of fresh fruits and salad vegetables has increased. For Canada, with its northern temperate climate, this change in consumption patterns has meant an increase in the demand for imported fruits and vegetables.

Tomatoes are the most important fresh vegetable imported by Canada. Although the winter tomato market has received extensive analysis in the United States (Bredahl et al.; Buckley et al.; Schmitz et al.; Shonkwiler and Emerson), the focus of this research has been Mexican-U.S. competition for the U.S. market and excluded Canada. Over 85 percent of Canadian tomato imports were supplied by the United States, and most of the balance by Mexico. Despite the growing value of these imports and their importance to Canada, there has been a paucity of Canadian research in this field.

Commercial Policy

The level of protection for the horticultural industry in Canada has increased significantly in recent years. Since 1976, the Canadian dollar has depreciated over 30 percent vis a vis the U.S. dollar, while import tariffs on fresh vegetables have increased. In

1979, a seasonal import tariff of ten percent (ad valorem) was introduced for fresh tomatoes. The tariff applies only to the period beginning in May and ending in October or November when domestic production is available. During the off-season (approximately December - April), the Canadian import duty on fresh tomatoes is zero. In 1980, the seasonal tariff was increased a further five points to 15 percent (ad valorem).

The coverage of the tariff varies from year to year and regionally across Canada. Canadian customs has divided the country into three zones (west, central and east) and the seasonal tariffs are initiated in each region when domestic production commences.

The economic rationale for the tariff is questionable for large parts of Canada. For example, consumers in Manitoba pay an import tariff for six months of the year, but have no local commercial production and receive minimal volumes of domestic tomatoes from other parts of the country. Similarly, a tariff is collected in all parts of the country during spring and fall periods of the year when the limited supplies of domestic greenhouse tomatoes are available only at local markets.

Although estimates of demand for fresh tomatoes in Canada have been calculated (Kulshreshthra, Hammig and Mittelhammer), these studies assume Canada to be a homogeneous market and ignore the possibility of regional differences. Previous studies also fail to provide estimates of the seasonality of Canadian tomato demand, or to test the price linkage which is assumed to be perfect (Hammig and Mittelhammer) between Canada and the United States.

This will attempt to integrate the definition of a market into a simple commodity trade (Canadian import demand for fresh U.S. tomato) model. The market definition aspect of the study is undertaken to assess whether indeed there are regional differences in the tomato market, an issue which has been ignored by other studies. The modeling of the trade side is kept as simple as possible. The advantages and disadvantages of the model adopted here are well discussed in Thompson (1981) and as such, almost no literature review on trade modeling is presented.

An Econometric Model of Canadian Demand for Imported Tomatoes

Most studies of the tomato market in Canada make no distinction between regional or city effects of prices on imported tomato demand. If policy measures are to be taken to protect the domestic tomato sector, the differential effects of these measures on the regions have to be clearly distinguished. The purpose of this section is to present the results of a simple model that accounts for the differential effects of prices and tariffs on imported tomatoes in four cities.

The results of the previous section indicates that there is no "national" tomato market. The statistical results based on the geographic definition of a market thus provides us with a starting point that would enable the differential aspects of the various markets to be incorporated in the econometric model.

In a partial equilibrium framework, assuming there are no stocks held, and market clearance in each region, the quantity imported (Q_t^I) equals the excess demand (Q_t^E) in that market; i.e.,

$$Q_t^I = Q_t^E = D(P_t^d) - S(P_t^d) \tag{14}$$

where D (.) and S(.) are the regional demand and supply respectively, all expressed as a function of the regional price. In addition to the import demand equation, we need a price transmission mechanism that links the foreign price P^w to the domestic price P^d:

$$P_t^d = P\ (P_t^w,\ \Gamma\ (X)\ ) \tag{15}$$

where Γ (.) is a vector of exogenous variables including some intervention variables; i.e., tariffs. Since we are only interested in the import side of the tomato market, these two equations will suffice for the analysis and effects of tariffs and exchange rates on imported tomatoes.

If the law of one price holds in equation (15), then the price transmission equation in the absence of tariffs, subsidies or transportation regulations is simple. However, in Canada, there is a tariff imposition on tomato imports from the United States. In addition, the tariff structure is different for the various regions in the country. For example, Toronto and Montreal being in central Canada, have a common tariff structure. The cities of Winnipeg and

Vancouver, being in the west, have a tariff structure which is different from their counterparts in central Canada. The reasons for these different tariff structures are beyond the scope of this study. However, it should suffice to point out that the rationale for these differences are to be formed in the Canadian governments' use of tariffs as a tool in regional economic development and expansion.

Data and Model Specification

Monthly data covering the period January 1977 to December 1985 are employed in this study. Tomatoes are imported into the four cities under analysis on a year round basis. Domestic production of tomatoes in Canada is limited to only certain months of the year. In order to account for the effects of limited domestic production on prices, six monthly dummy variables are included in the price equation. Population instead of per capita income was included in the import demand equation as a demand shifter. In addition, the real wages earned per worker in each city are also included as a proxy variable to account for the cost of producing domestic tomatoes in each region. The wage and population variables are available only on a quarterly basis so they were interpolated to obtain the monthly proxies.

The conceptual model adopted for this study consists of two equations. Because about 85 percent of tomatoes imported into Canada are from the U.S., a "small country" assumption was maintained in building the model. The specified model is recursive and comprises the import demand and a price linkage equation.[1] In the specification adopted here, imports and prices are expected to have desired long run levels which are functions of certain key variables.

Desired Import Demand

$$IMPORTS^{*}_{t} = B_0 + B_2RPIMPT + B_3RWWAGES + B_4POPN + B_5RVPINDX \quad (16)$$

$$B_2 < 0; \quad B_3 > 0; \quad B_4 > 0; \quad B_5 \lesseqgtr 0.$$

The desired price linkage equation takes the form:

$$RPIMPT^{*}_{t} = \alpha_0 + \alpha_2 RFOBUS + \alpha_3 EXRATE + \alpha_4 TARIFF + \alpha_5 RATIO + \alpha_6 CPIC \quad (17)$$

and

$$\alpha_2 > 0; \quad \alpha_3 > 0; \quad \alpha_4 > 0; \quad \alpha_5 > 0; \quad \alpha_6 = \alpha_2 - 1; \quad \alpha_2 = \alpha_5$$

Variable definitions and mnemonics for the above equations are found in Table 10. The dynamics in imports and prices are modeled by assuming that actual imports (prices) are related to their desired levels through the following mechanism:

$$\ln Q_{it} - \ln Q_{it-1} = \phi_i (\ln Q^{*}_{it} - \ln Q_{it-1}) \quad (18)$$

---

[1]The functional form chosen for the above specification is double logarithmic.

Table 10

Definition of Variables in Equations

IMPORTS:	quantity of tomatoes imported from the U.S. into city i
IMPORTSL:	lagged IMPORTS
RPIMPT:	real wholesale price of tomatoes in city i
RPIMPTL:	one period lag of RPIMPT
RFOBUS:	real price of tomatoes (U.S.) FOB
EXTRATE:	Exchange rate, Canadian$/U.S.$
TARIFF:	expressed as (1 + TARIFF)
RATIO:	ratio of city i's CPI to U.S. CPI
CPIC:	CPI in the i-th Canadian city
POPN:	population of province in which i-th Canadian city is located, used as a proxy for income
RWWAGES:	real wages in i-th city, used as a proxy for the cost of producing tomatoes in region i.
RVPINDX:	real vegetable price index in the i-th city
DUM1 - DUM12:	monthly seasonal dummies, Jan=1, Dec=12
CITDUM1:	city dummy equals 1 if Montreal; else equal zero
CITDUM2:	city dummy equals 1 if Toronto; else equal zero
CITDUM3:	city dummy equals 1 if Winnipeg; else equal zero
CITDUM4:	city dummy equals 1 if Vancouver; else equal zero

where Q_i = (IMPORTS, RPIMPT) and ϕ_i's are the adjustment coefficients such that $0 \leq \phi_i < 1$. If there is a complete adjustment in a single time period, then we should expect $\phi_i = 1$.

On substituting equations (16) and (17) into (18) yield:

$$IMPORTS_t = \beta_0' + (1-\phi_1)IMPORTSL + \beta_2' RPIMPT_t + \beta_3' RWWAGES_t + \beta_4' POPN_t + \beta_5' RVPINDX_t + u_{1t} \quad (19)$$

$$RPIMPT_t = \alpha_0' + (1-\phi_2)RPIMPTL + \alpha_2' RFOBUS_t + \alpha_3' EXRATE_t + \alpha_4' TARIFF_t + \alpha_5' RATIO_t + \alpha_6' CPIC_t + u_{2t} \quad (20)$$

where $\beta_i' = \phi_1 \beta_i$ and $\alpha_i' = \phi_2 \alpha_i$.

The inclusion of lagged dependent variables is an attempt to capture the stock effects in (19) and also, costs to changing the price of tomatoes in (20). In equations (19) and (20), the short run effects of the explanatory variables on imports and prices are given by β_i's and α_i's.

To allow for geographic price effects in equation (20), we let:

$$\alpha_0' = \alpha_0'' + \sum_{i=1}^{3} \delta_i CITDUM$$

Where CITDUMi

$$CITDUMi = \begin{cases} 1 & \text{for city } i \\ 0 & \text{otherwise} \end{cases}$$

These city-specific dummies are added to the price equation to examine whether the market are indeed different in the econometric specification. An F-test based on the joint hypothesis that $\delta_1 = \delta_2 = \delta_3$ is then performed to test the validity of the many market hypothesis.

The law of one price (LOP) can be tested in the price equation by evaluating whether the coefficients on the exchange rate and the U.S. price equal to unity. If this condition holds, then there is full integration in Canada-U.S. tomato trade. The implication then will be that a one-percentage change in tomato prices between the two countries should be fully reflected in a corresponding one-percentage change in the exchange rate.

Estimation - Pooled Data

In estimating the import demand and price transmission equations from pooled data, the procedure suggested in Kmenta (1972) was followed. The dynamic and static versions of the equations were estimated. The dynamic versions included lagged dependent variables.

Estimates of the static model are presented in Table 11. The signs of the estimated coefficients are consistent with a priori expectations. Many of the estimated coefficients are significant at the 5 percent level.

In the price equation, the estimated results indicate that a one-percent increase in the exchange rate leads to a 0.22 percent increase in the Canadian price of imported tomatoes. This implies that the

Table 11
Structural Estimates of the Tomato Model[a)]

	RPIMPT	IMPORTS
Incercept	1.3827(14.637)[b]	-2.6186(2.155)
RFOBUS	0.7316(23.126)	-
EXRATE	0.2176(8.376)	-
TARIFF	0.4145(2.674)	-
RATIO	0.7316(23.126)	-
CPIC	-0.2683(8.482)	-
RPIMPT	-	-0.3578(4.364)
RWWAGES	-	0.8596(4.183)
TPOPN	-	0.6804(28.179)
RVPINDX	-	-0.5236(1.764)
DUM1	-	0.0051(0.058)
DUM2)	-	0.1517(1.717)
DUM3	-	0.1554(1.743)
DUM4	-	0.2714(3.009)
DUM5	0.0614(2.087)	0.3397(3.827)
DUM6)	-0.0411(1.315)	0.1498(1.652)
DUM7	-0.0031(0.100)	-0.2759(2.951)
DUM8	0.0622(2.322)	-0.3606(4.020)
DUM9	-0.0384(1.413)	-0.6724(7.830)
DUM10	-	-0.3392(3.950)
DUM11	-	0.0324(0.376)
CITDUM1	-0.1139(5.661)	-
CITDUM2	-0.1609(7.998)	-
CITDUM3	0.0292(1.453)	-
DW	1.471	1.608

SYSTEM STATISTICS

	RPIMPT	IMPORTS
$\Sigma =$	0.0192	0.0006
	-	0.1097

WEIGHTED R^2 0.7628
WEIGHTED MSE 0.9999

[a)]The reported estimates refer to the static version.
[b)]Absolute t-values in parentheses.

pass-through effect of the exchange rate on Canadian prices is not perfect. On the other hand, a one percent increase in the U.S. f.o.b. price leads to a 0.7 percent increase in the Canadian price of tomatoes.

The remainder of the discussion that follows is based on the dynamic versions of the model represented by equation (19) and (20). An assessment of the validity of the law of one price and differential city price effects will be fully discussed on the basis of the dynamic equations as well.

Import Demand

The parameter estimates for the dynamic version of the model are presented in Table 12. The coefficient on the lagged dependent variable is .209, indicating that about 79 percent of the gap between current tomato imports and actual past import levels was closed in a single month.

The short and long run price elasticities of Canadian excess demand for U.S. tomatoes are -0.306 and -0.387, respectively. These elasticities suggest that Canadian tomato imports are responsive to price on a monthly basis albeit inelastic. The proxy variable for the cost of tomato production in Canada RWWAGES is also significant and roughly about twice the size of the price elasticity. The real vegetable price index has an elasticity of -0.62 suggesting that the vegetable group is a complement to tomatoes. Eight out of the eleven

Table 12
Structural Estimates of the Tomato Model[a)]

	RPIMPT	IMPORTS
INTERCEPT	1.8656(20.785)[b]	-2.1590(2.085)
RPIMPTL	0.2463(7.664)	-
RFOBUS	0.6277(23.437)	-
EXRATE	1.1795(9.509)	-
TARIFF	0.7252(4.398)	-
RATIO	0.6277(23.437)	-
CPIC	-0.3723(13.902)	-
RPIMPT	-	-0.3060(4.118)
IMPORTSL	-	0.2091(4.479)
RWWAGES	-	0.7052(3.872)
TPOPN	-	0.5417(14.156)
RVPINDX	-	-0.6184(2.925)
DUM1	-	0.0712(0.931)
DUM2	-	0.1748(2.319)
DUM3	-	0.1567(2.053)
DUM4	-	0.2845(3.690)
DUM5	0.0409(1.326)	0.3292(4.394)
DUM6	-0.0499(-1.681)	0.1291(1.678)
DUM7	-0.0345(1.157)	0.2996(3.886)
DUM8	0.0553(1.835)	-0.3668(4.877)
DUM9	0.0720(2.361)	-0.5393(7.051)
DUM10	-0.0213(0.706)	-0.1778(2.234)
DUM11	-	0.1271(1.689)
CITDUM1	-0.0707(3.621)	-
CITDUM2	-0.1095(5.503)	-
CITDUM3	-0.0033(0.175)	-
W	1.917	2.001

SYSTEM STATISTICS	RPIMPT	IMPORTS
Σ =	0.0197	0.0008
	-	0.0963
WEIGHTED MSE 0.9999		
WEIGHTED R^2 0.7816		

[a)] The reported estimates refer to the dynamic version
[b)] Absolute t-values in parentheses.

monthly dummies included in the import equation are highly significant at the 5 percent level. This result indicates that there is a definite seasonal pattern in Canadian imports of tomatoes from the U.S.

Price Transmission

The estimated coefficients of the price linkage equation conform to a priori expectations. The included lagged price is significantly different from zero. A strong relationship exists between the U.S. fob and the Canadian wholesale price. However, in testing for the law of one price, it is rejected by the tomato data. The t-values for the test that the coefficient on RFOBUS and EXRATE equal unity are -13.91 and 1.47 respectively. This rejection of the law of one price is not surprising since it is in accord with a lot of the empirical results presented elsewhere (e.g., Bredahl et al (1983), Torok and Huffman (1986)).

An F-test was performed to test the hypothesis that there are no geographic effects in the price equation (i.e., common intercept for all cities). The calculated F-value is 14.0304 with a marginal significance level of 0.0001. These results confirm our earlier suspicion that indeed the tomato market in Canada cannot be classified as one market. On a western-central Canadian dichotomy of the model, the estimated results also indicate that the price equation for the two regions do not have a common intercept. Even though the statistical results on the test of one market or many were inconclusive, the econometric results provide strong evidence that there is more than one tomato market in Canada.[2]

The tariff variable has a strong and positive effect on the wholesale price of imported tomatoes. The estimated coefficient suggests that a one-percentage point increase in the tariff index leads to a 0.73 percent increase in the wholesale price of Canadian tomatoes. The effect of the tariff on imports over the longer run is approximately -0.372. This means that over the long run, a 1 percent increase in the tariff index will lead to a 0.37 percent reduction in the quantity of tomatoes imported. The total effects of exchange rate, tariffs and the U.S. fob price on Canadian imports and price are discussed in the next section.

Dynamics of Tomato Import Demand[3]

In this section, the estimated model is used to obtain the reduced form parameter estimates. With the reduced form, the dynamic properties of the model can be investigated by examining the path of the interim multipliers.

In vector notation, the structural model can be rewritten as:

$$GY_t + CY_{t-1} + BX_t = \epsilon_t \tag{21}$$

---

[2]Individual market results are reported in Tables D1 to D4 in Appendix D. Table C5 in the Appendix also reports model results based on a dichotomy between western-central Canada.

[3]This section is based on Chapter 14 of Intrilligator (1978).

Premultiplying both sides of (21) by G^{-1} and rearranging terms yields:

$$Y = \Pi_1 Y_{t-1} + \Pi_2 X_t + U_t \qquad (22)$$

where

$$\Pi_1 \equiv -G^{-1}C; \quad \Pi_2 \equiv -G^{-1}; \quad U_t \equiv G^{-1}\epsilon_t$$

Equation (22) represents the endogenous variables as functions of lagged endogenous and exogenous variables and is often referred to as the reduced form. Since our reduced form equations contain lagged endogenous variables (i.e., we have a difference equation in Y_t), each equation can be solved iteratively to obtain its final form. In this form, each current endogenous variable is expressed as a function of current and past exogenous variables and white noise terms. The coefficients attached to each exogenous variable are called the dynamic multipliers. The final form in effect allows us to examine the influence of past policy measures on the current endogenous variables.

By repeated substitution, the final form obtained from (22) is:

$$Y_t = Y_0 \Pi_1{}^t + \sum_{j=0}^{t-1} \Pi_2 \Pi_1{}^j X_{t-j} + \sum_{j=0}^{t-1} \Pi_1{}^j U_{t-j} \qquad (23)$$

From this, the impact multipliers are obtained as:

$$\frac{\partial Y_t}{\partial X_{t-1}} = \Pi_2 \Pi_1{}^j \qquad \text{for } j = 0, 1, \ldots t-1$$

The t-period cumulative multiplier, on the other hand, measures the effect on each endogenous variable of a change in an exogenous variable over t-period;

$$\left.\frac{\partial Y}{\partial X_t}\right|_t = \sum_{j=0}^{t-1} \Pi_2 \Pi_1^j$$

Over the longer run (i.e., t --> ∞), the long term multiplier is:

$$\left.\frac{\partial Y}{\partial X_t}\right|_\infty = \lim_{t \to \infty} \Pi_2 (1 + \Pi_1 + \Pi_1^2 + \ldots + \Pi_1^t) = \Pi_2 (1 - \Pi_1)^{-1}$$

These long term multipliers indicate the total cumulative effect of a permanent sustained increase in an exogenous variable in the system on the endogenous variables.

Dynamic Results

The estimated reduced form matrices Π_1 and Π_2 determine the dynamic properties of the model. The reduced form parameterization shows that the effect of RFOBUS, EXRATE and TARRIF variables all have a positive impact on the Canadian wholesale price of tomatoes. These same variables, however, have a negative impact on the quantity of tomatoes imported. The interesting point to note here is that whereas the U.S. f.o.b. price has the smallest impact on the Canadian price and quantity imports, it is the exchange rate that has the dominant effect on the endogenous variables. The effect of the exchange rate on price and imported quantity is roughly twice that of the U.S. f.o.b. price. With regard to the exchange rate, a 10 percent depreciation of the Canadian dollar against the U.S. dollar ceteris paribus, leads to an initial 11.8 percent increase in the wholesale price of Canadian tomatoes and a 3.61 percent reduction of the quantity imported.

The intermediate and long-run effects of the U.S. f.o.b. price, exchange rate, and the tariff on the dynamics of Canadian price and quantity imported are presented in Tables 13 and 14 respectively. The long-run response of Canadian tomato price to the exchange rate is 1.56, compared to 0.83 for the U.S. f.o.b. price and 0.96 for the tariff index. The long-run response of quantity imported to the exchange rate is -0.61 compared to about -0.37 for the tariff and, -0.32 for the U.S. f.o.b. price.

Figures 1 and 2 show the plots of intermediate run elasticities for Canadian price and quantity imported of tomatoes to a change in the U.S. f.o.b. price, the Canadian/U.S. dollar exchange rate, and the tariff index. The effect of an increase in each of these variables on Canadian price lead to an immediate increase on prices in all three cases. On the average, the full impact of an increase in these variables is realized within six months. The response of imported quantity to these same variables (Figure 2) cause a similar response but in the opposite direction. All the elasticities decrease in magnitude over time taking approximately six months to reach their respective steady state levels.

Table 13

Selected Interim, Cumulative, Interim and
Total Price Elasticities[a)]

	Price (RPIMPT)		
Lags	RFOBUS	EXRATE	TARIFF
0	0.6277(0.6277)	1.1795(1.1795)	0.7252(0.7252)
1	0.154610.7825)	0.2906(1.4701)	0.1786(0.9038)
2	0.0381(0.8204)	0.0716(1.5417)	0.0440(0.9478)
3	0.0094(0.8298)	0.0176(1.5593)	0.0108(0.9586)
4	0.0023(0.8321)	0.0043(1.5636)	0.0027(0.9613)
5	0.0006(0.8317)	0.0011(1.5647)	0.0006(0.9619)
6	0.0001(0.8328)	0.0003(1.5650)	0.0002(0.9621)
.			
.			
.			
∞	0 (0.8328)	0 (1.5650)	0 (0.9623)

[a)]Figures in parentheses are the cumulative interim multipliers.

Table 14

Selected Interim, Cumulative, Interim and Total Import Elasticities[a)]

Lags	RFOBUS	EXRATE	TARIFF
0	-0.1921 (-0.1921)	-0.3609 (-0.3609)	-0.2219 (-0.2219)
1	-0.0875 (-0.2796)	-0.1644 (-0.5253)	-0.1011 (-0.3230)
2	-0.0299 (-0.3095)	-0.0563 (-0.5816)	-0.0346 (-0.3576)
3	-0.0091 (-0.3186)	-0.0172 (-0.5988)	-0.0105 (-0.3681)
4	-0.0026 (-0.3212)	-0.0049 (-0.6037)	-0.0030 (-0.3711)
5	-0.0007 (-0.3219)	-0.00183(-0.6050)	-0.0008 (-0.3719)
6	-0.0002 (-0.3221)	-0.0004 (-0.6054)	-0.0002 (-0.3721)
.			
.			
.			
∞	0 (-0.3221)	0 (-0.6055)	0 (-0.3723)

a)Figures in parentheses are cumulative interim multipliers

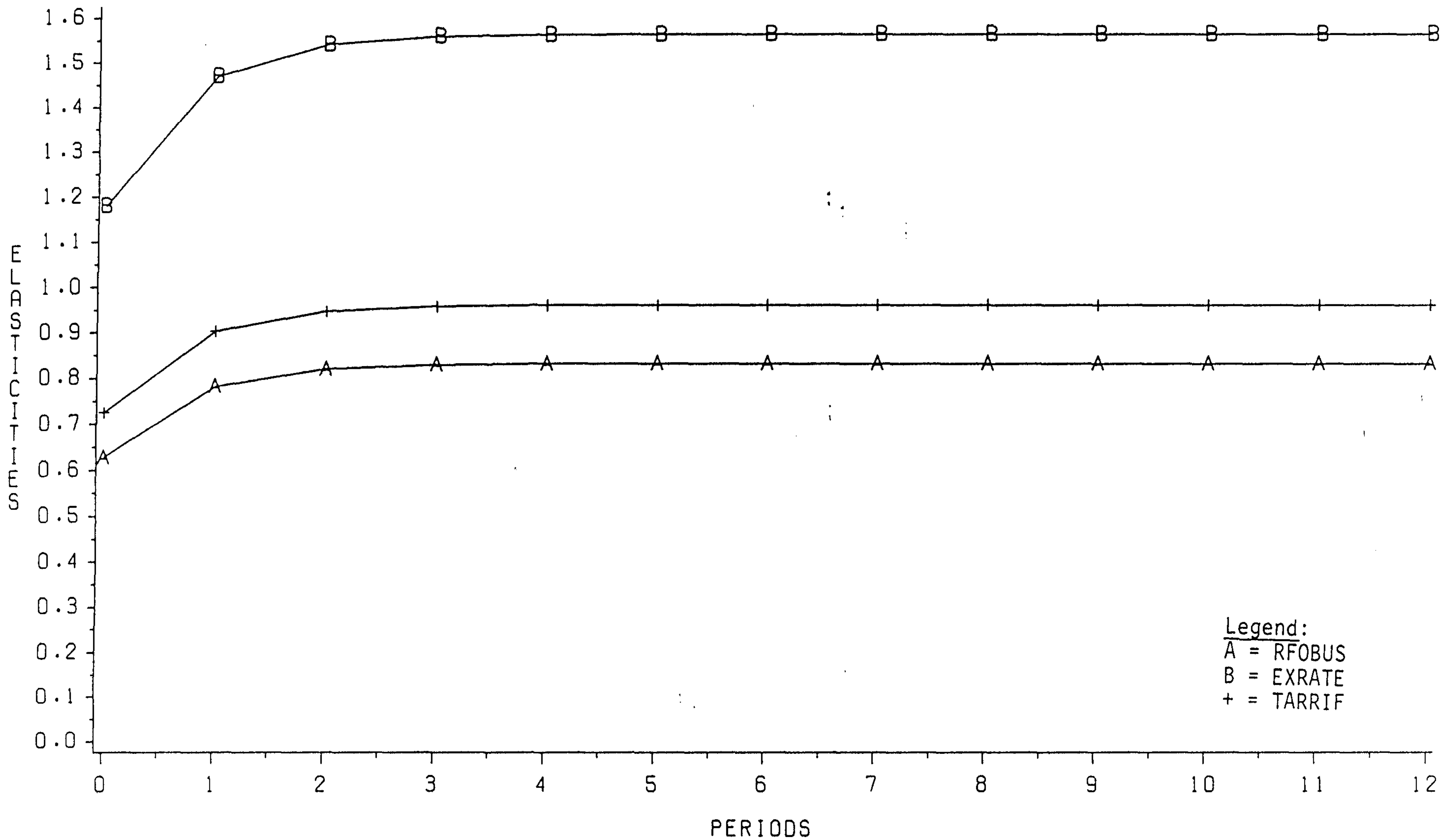

FIGURE 1
INTERMEDIATE RUN ELASTICITIES OF PRICE

SOURCE: MODEL SIMULATIONS

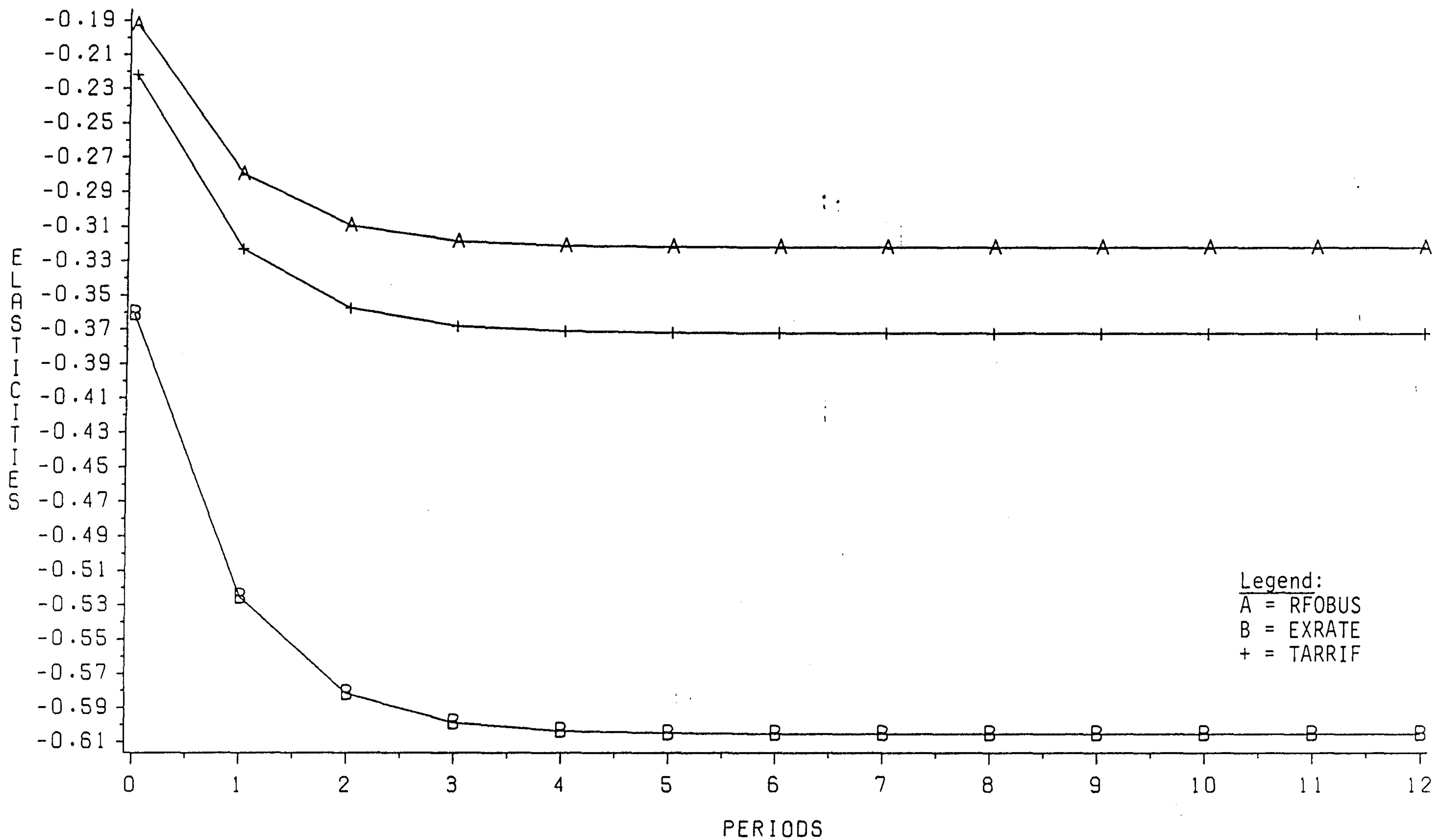

FIGURE 2
INTERMEDIATE RUN ELASTICITIES OF IMPORTS

SOURCE: MODEL SIMULATIONS

Summary and Conclusions

In Part I of this study, preliminary analyses were used to determine the "one-ness" of a national tomato market in Canada. The Statistical results to determine whether a single market exists for tomatoes provide conflicting conclusions. Whereas the Horowitz procedure tends to confirm the existance of one national tomato market, the other procedures indicate otherwise. The power of each test has not been evaluated against that of the Horowitz procedure but it is the belief that the other tests are more informative than the regression based approach of Horowitz.

How do the results of this testing compare with others? As far as we know, there are no comparable studies in Canada that have examined the issue of one market or many for tomatoes, or for that matter, any other commodity. However, it should be pointed out that since the generalized Horowitz and multivariate causality procedures depend on the historical evolution of nominal prices without adjustment for transaction costs, the time series procedures used will have to be refined before a definite conclusion can be reached.

The results of this study cast doubt on the validity of aggregate demand analysis as it is currently pursued. If it is not possible to conclude that a national market exists for tomatoes, it may be similarly unlikely that a national market exists for other fresh fruits and vegetables. Even more unlikely is the possibility of a national market for heavily regulated commodities, such as fluid milk, which is subject to strict provincial regulation that inhibits interprovincial trade. Consequently, the aggregate price and income elasticities reported by Hassan and Johnson[4] for fruits and vegetables, dairy products and several other food commodities are questionable. In turn, the concept of a full demand matrix for food products in Canada, or for that matter in any country which has significant regional markets, is compromised and needs to be reconsidered.

In the second part of the study, an econometric model on the Canadian demand for imported tomatoes is presented and the estimated results reported. Attention in this section focused on the inclusion of city dummies into the price linkage equation. Also, the discussion was mainly about the dynamic version of the model since the interest was to assess the dynamics of the tomato market.

The city differential effects in prices are captured by the three dummy variables included in the price linkage equation. All three variables were negative but only Montreal and Toronto were highly significant. This implies that on the average we should expect wholesale prices in Montreal and Toronto to be lower relative to the prevailing price in Vancouver.

The law of one price was tested in the price linkage equation but rejected. This suggests a form of price transmission between U.S. and Canadian prices that is not perfect as the law of one price would lead us to believe. Thus, the degree of integration in Canada-U.S. tomato trade is not fully realized. This finding should be of relevance to U.S. researchers who have tended to ignore the impact of Canada on the

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[4]Zuhair A. Hassan and S.R. Johnson (1976). Consumer Demand for Major Foods in Canada, Agriculture Canada, Research Report No. 76/2, April.

U.S. tomato market, or to treat Canada as if it were the fifty-first state.

What are the policy conclusions to be drawn from the import demand side? To answer this, we look at the effects of U.S. f.o.b. price (FOBUS), the Canadian-U.S. dollar exchange rate (EXRATE) and the Canadian tariff (TARIFF) on Canadian prices and quantity imported. The dynamic aspects of the model show that if the tariff is a mechanism to discourage imports of U.S. tomatoes, it is not as effective as the depreciation of the Canadian dollar against the U.S. dollar. On the price side of the model, the exchange rate effect also dominates the effect of the Canadian tariff. However, the combined effect of the tariff and U.S. f.o.b. price dominates that of the exchange rate on both prices and imports in the long run.

An issue which has not been addressed is the benefit and cost side of the tariff structure to consumers and greenhouse producers of Canadian tomatoes. Obviously, if the combined effect of fluctuations in the exchange rate and U.S. f.o.b. price are passed on to consumers in its entirety at the retail level, the extra burden from the tariff on consumers is unwarranted. This is particularly the case in the regions of Canada which have no significant volume of commercial tomato production such as the Winnipeg market.

References

Abbot, P.C., "Modeling International Grain Trade with Government-Controlled Markets." AJAE 61 (1979): 22-31.

Agriculture Canada, Annual Unload Report, Marketing and Economics Branch (annual).

Agriculture Canada, Fruit, Vegetable and Honey Crop and Market Report, Marketing and Economics Branch (weekly).

Bannock, Graham, R.E. Baxter, and Ray Rees, The Penguin Dictionary of Economics (2nd Ed.), Penguin Books, 1978.

Bredahl, Maury E. et al. Technical Change, Protectionism, and Market Structure: The Case of International Trade in Fresh Winter Vegetables. The University of Arizona, College of Agriculture, Agricultural Experiment Station, Bulletin 249, August 1983.

Bressler Jr., Raymond G. and Richard A. King, Markets, Prices and Interregional Trade, John Wiley and Sons Inc., New York, 1970.

Brorsen, B. Wade, Warren R. Grant, and Jean-Paul Charas, "Dynamic Relationships and Efficiency of Rice Byproduct Prices." Agricultural Economics Research, 37(1985): 15-26.

Buckley, Katharine C. et al. Florida and Mexico Competition for the Winter Fresh Vegetable Market. USDA-ERS, Agricultural Economic Report No. 556, June 1986.

Chambers, Robert G. and Richard E. Jush. "A Critique of Exchange Rate Treatment in Agricultural Trade Models." AJAE, 61 (1979): 249-57.

Cochrane, W.W., "The Market As a Unit of Inquiry in Agricultural Economics Research," Journal of Farm Economics, 39(1957): 21-39.

Collins, C., "Price and Exchange Rate Transmission," Agricultural Economics Research 32 (1980): 50-55.

Hammig, M.D. and R.C. Mittelhammer. "An Evaluation of Import Tariffs in the Canada-U.S. Fresh Tomato Market." Cdn. J. Agr. Econ. 30 (1982): 107-14.

Hassan, Zuhair A. and S.R. Johnson (1976). Consumer Demand for Major Foods in Canada, Agriculture Canada, Research Report No. 76/2, April.

Horowitz, I., "Market Definition in Antitrust Analysis: A Regression Based Approach." Southern Economic Journal (1981): 1-16.

Intrilligator, M., Econometric Models, Techniques and Applications. Prentice-Hall, 1978.

Kmenta, Jan, Elements of Econometrics, MacMillan Publishing Co., Inc. 1971.

Kulshreshtra, S.N. "The Demand for Major Fruits and Vegetables in Canada." Cdn. J. Agr. Econ. 18 (1970):52-9.

Monke, Eric and Todd Petzel, "Market Integration: An Application to International Trade in Cotton," AJAE 66(1984): 481-487.

Ravallion, Martin, "Testing Market Integration," AJAE 68(1986): 103-109.

Richardson, J.D., "Some Empirical Evidence of Commodity Arbitrage and the Law of One Price," Journal of International Economics 8(1978): 341-51.

Schmitz, Andrew, Robert S. Frich, and Jimmye S. Hillman, "Agricultural Export Dumping: The Case of Mexican Winter Vegetables in the U.S. Market." Amer. J. Agr. Econ. 63 (1981): 645-54.

Schub, G. Edward, "The Exchange Rate and U.S. Agriculture." AJAE 56(1974): 1-13.

Shonkwiler, J. Scott, and Robert D. Emerson. "Imports and the Supply of Winter Tomatoes: An Application of Rational Expections." Amer. J. Agr. Econ. 64(1982): 634-41.

Stigler, George J. and Robert A. Sherwin, "The Extent of the Market," Journal of Law and Economics 18 (1985): 555-585.

Thompson, Robert L., A Survey of Recent U.S. Developments in International Agricultural Trade Models. BLA-21. USDA, ERS, Sept. 1981.

Torok, S.J., and W.E. Huffman, "U.S.-Mexican Trade in Winter Vegetables and Illegal Immigration." AJAE 68 (1986): 246-260.

Uri, Noel D., John Howell, and Edward J. Rifkin, "On Defining Geographic Markets." Applied Economics 17(1985): 959-977.

USDA. Vegetable Situation and Outlook Report, USDA-ERS (semi-annual).

APPENDIX A

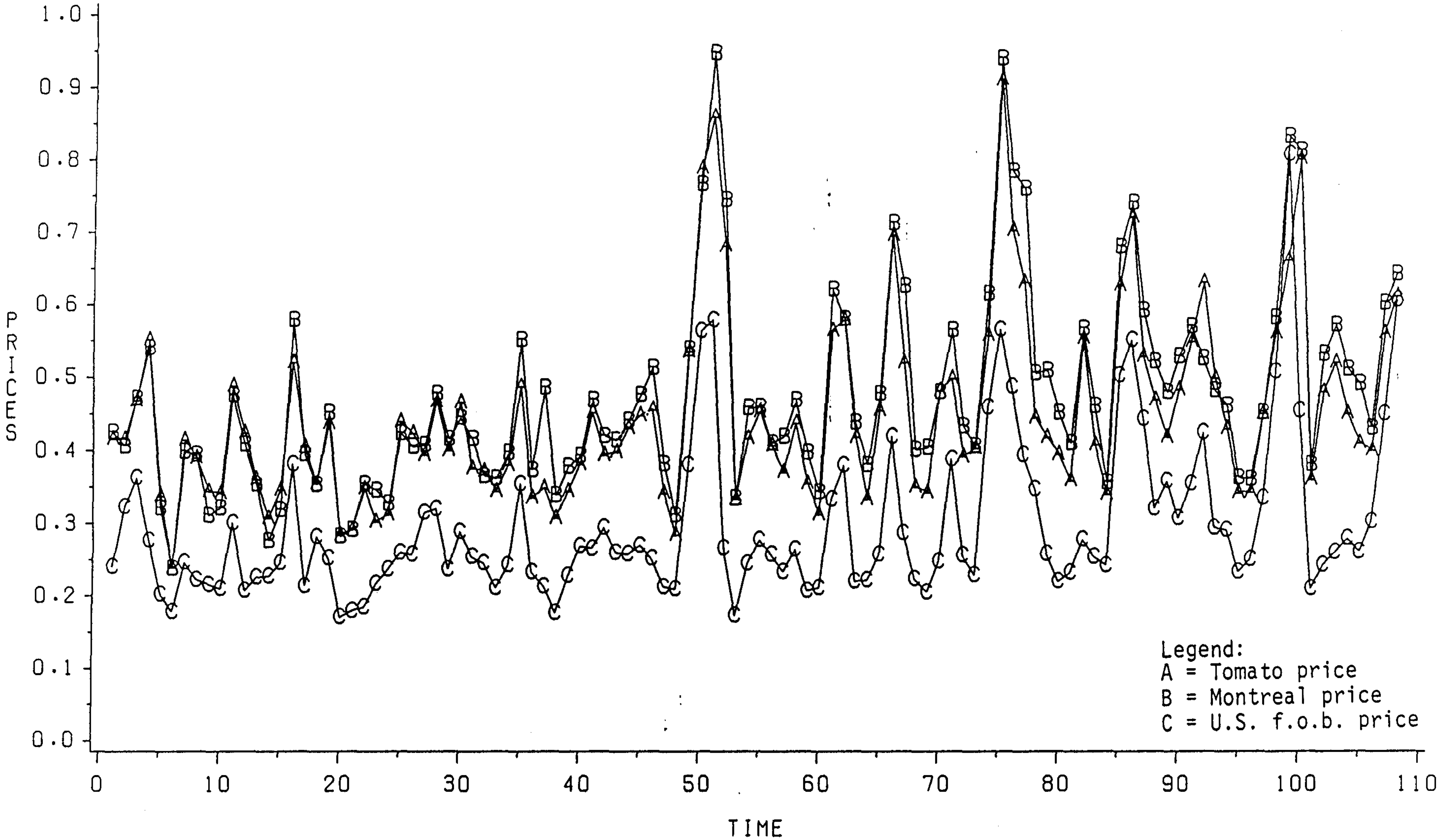

FIGURE A1
PRICE OF TOMATOES IN CANADA AND U.S.(FOB)

SOURCE: SAMPLE DATA

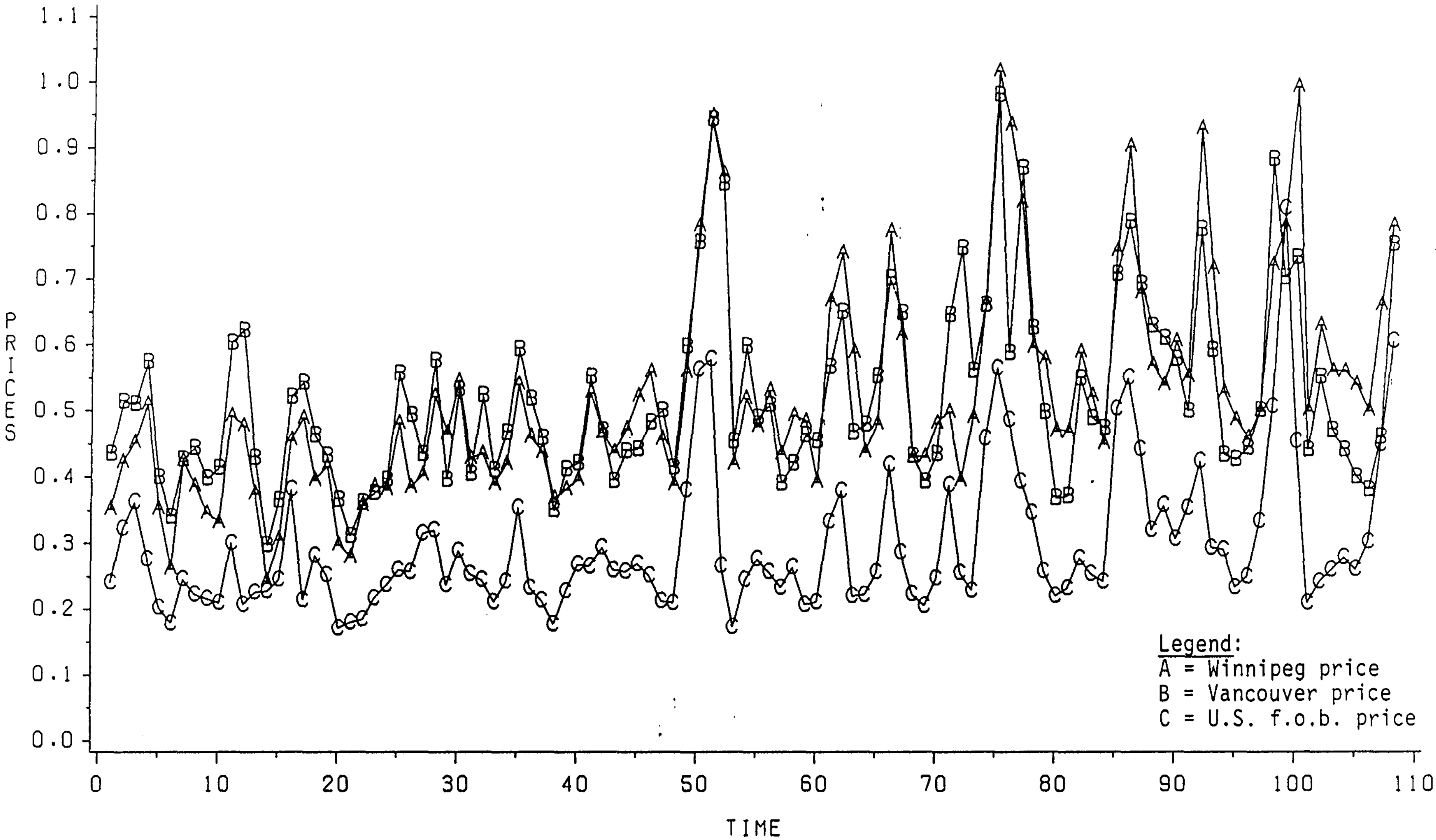

FIGURE A 2
PRICE OF TOMATOES IN CANADA AND U.S.(FOB)

SOURCE: SAMPLE DATA

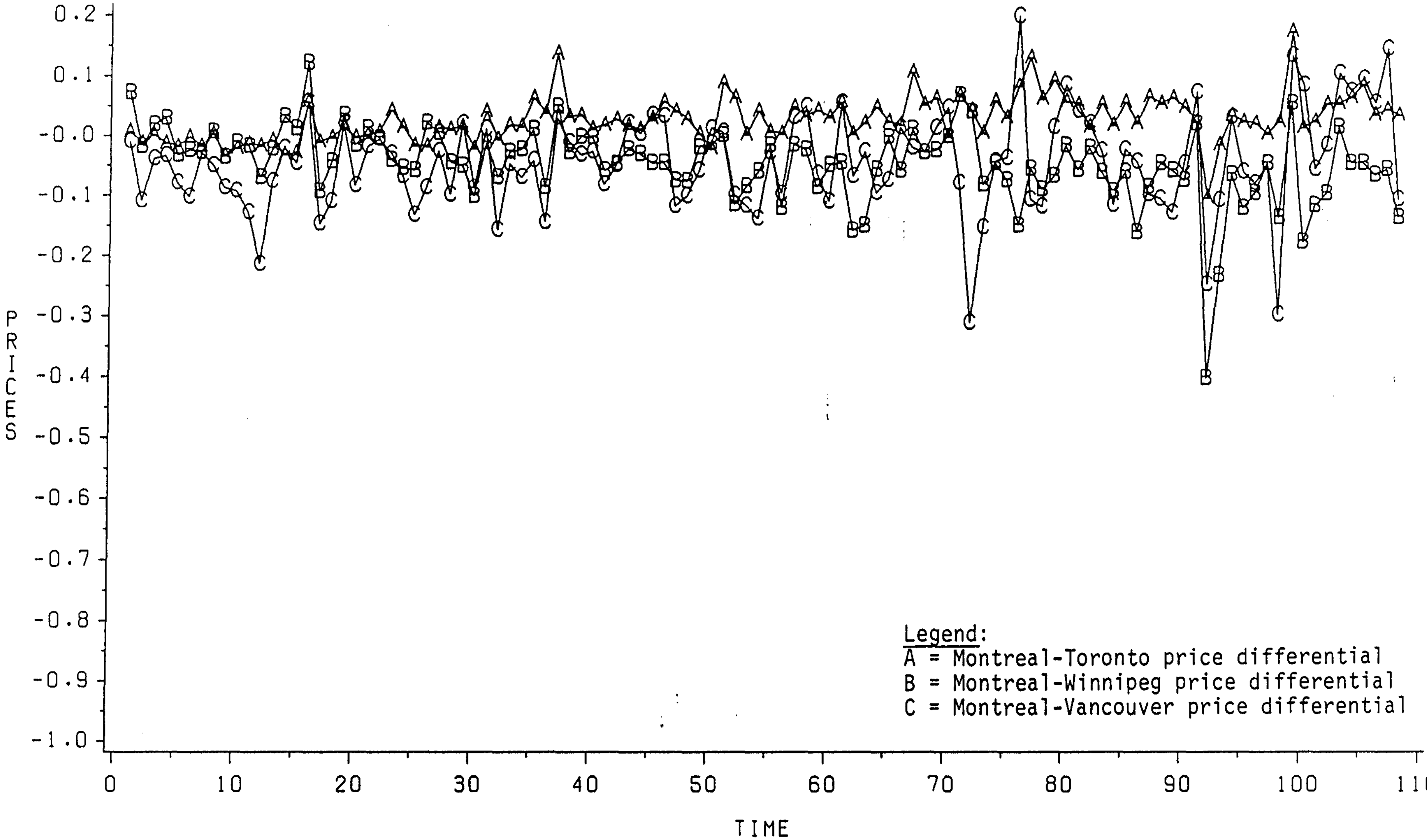

FIGURE A3
PAIRWISE TOMATO PRICE DIFFENTIALS

SOURCE: SAMPLE DATA

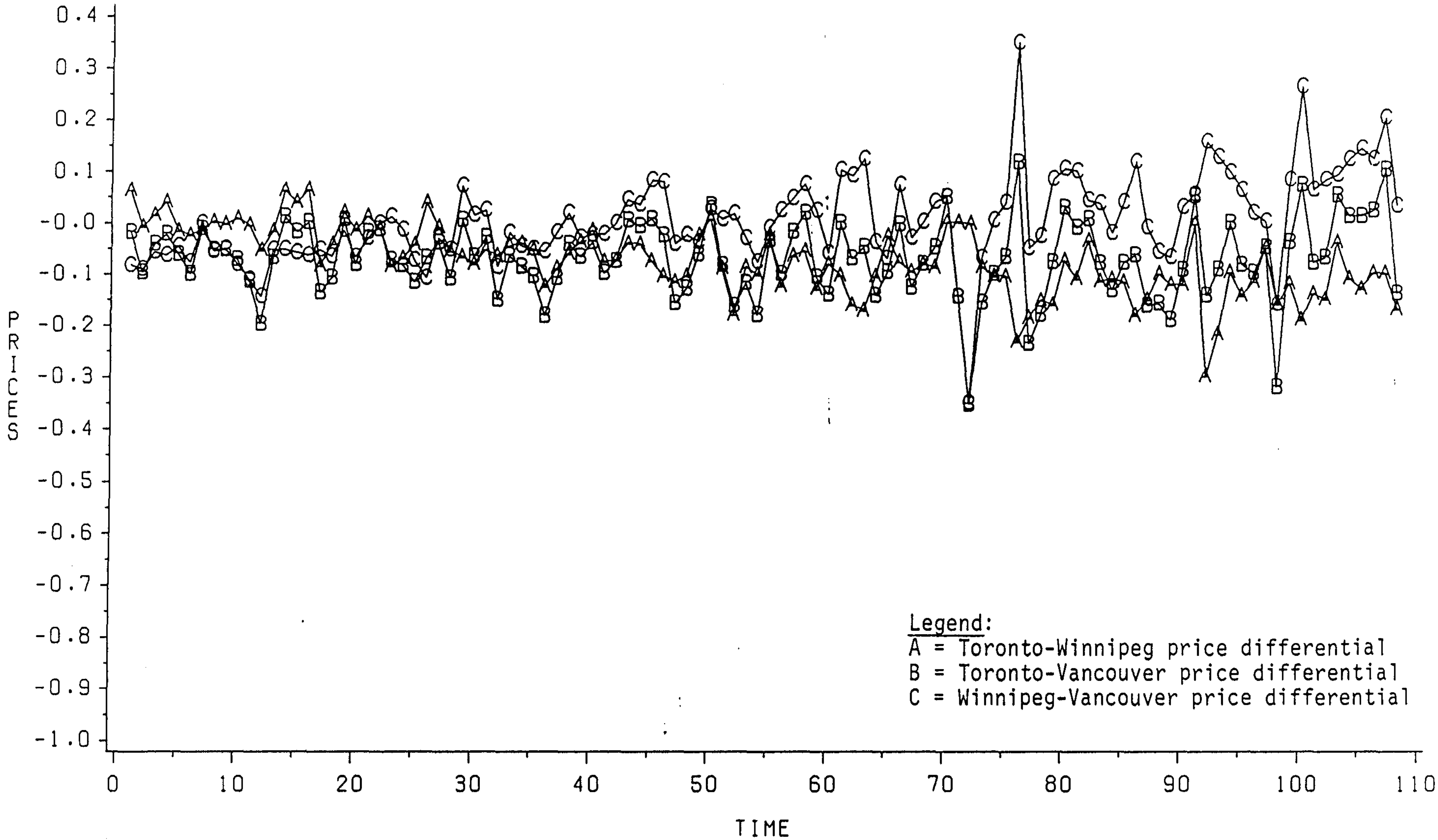

FIGURE A4
PAIRWISE TOMATO PRICE DIFFENTIALS

SOURCE: SAMPLE DATA

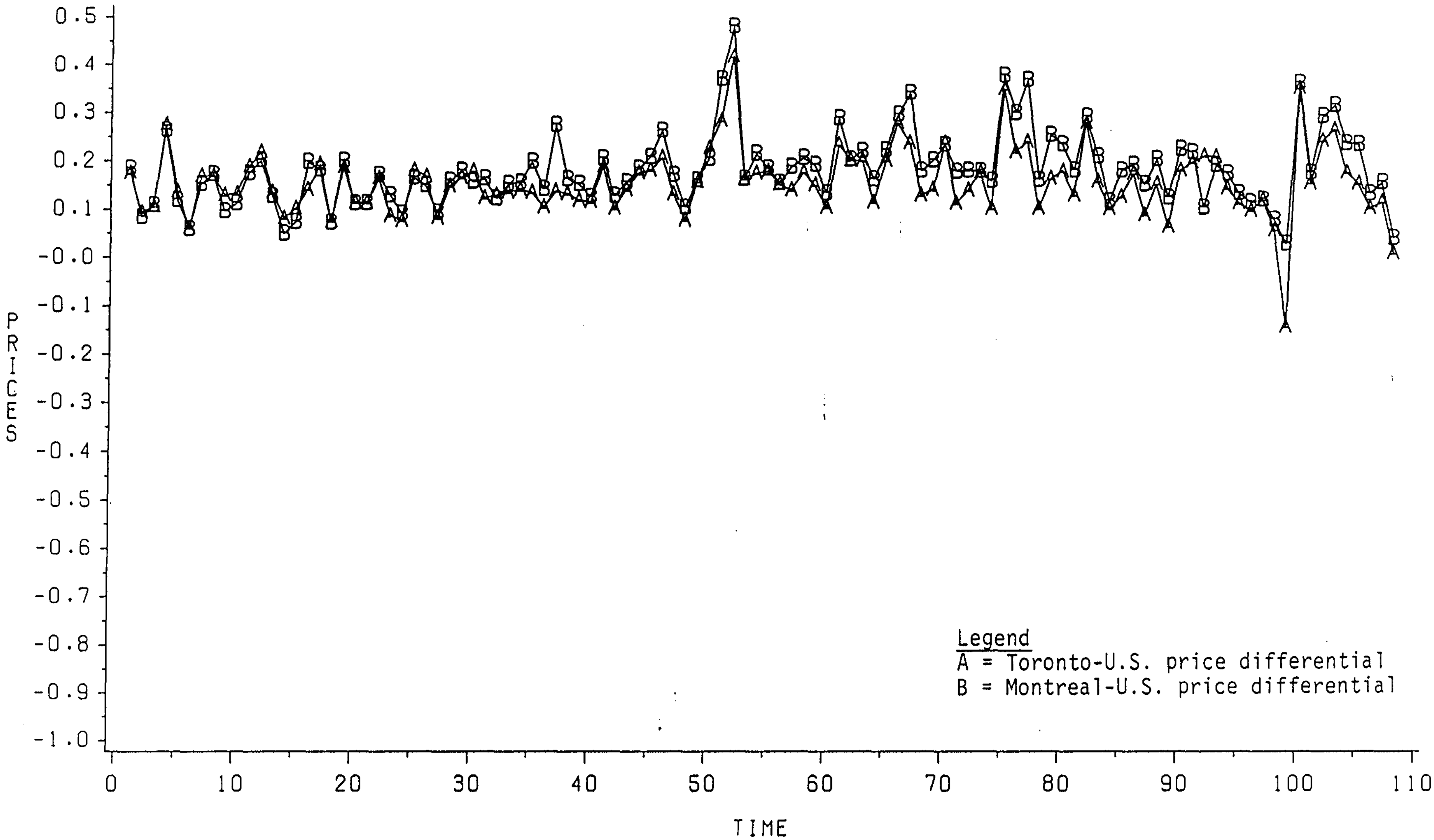

FIGURE A5
CANADA-U.S. TOMATO PRICE DIFFERENTIAL

SOURCE: SAMPLE DATA

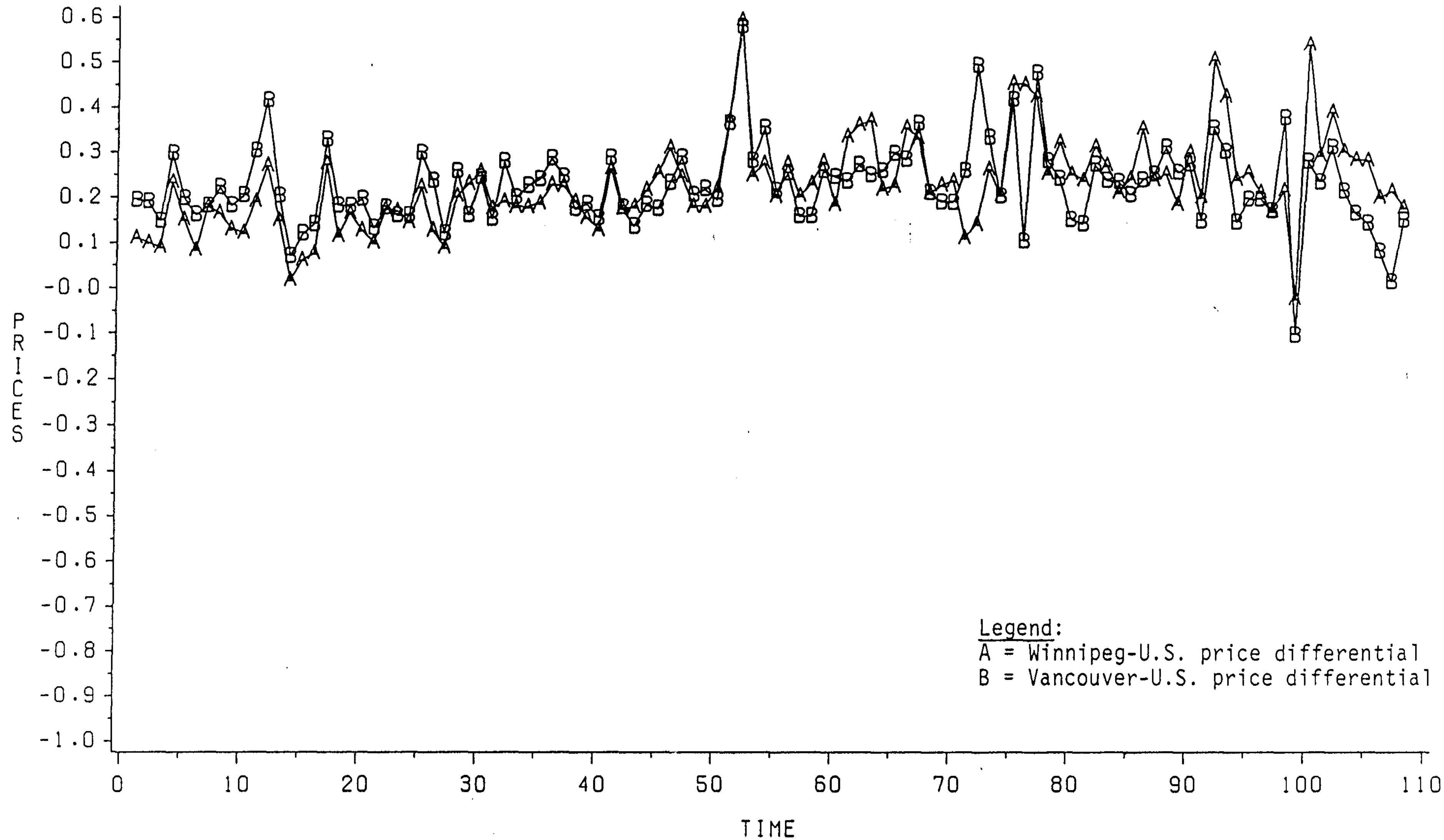

FIGURE A 6
CANADA-U.S. TOMATO PRICE DIFFERENTIAL

SOURCE: SAMPLE DATA

APPENDIX B

Table B1

Annual Average Tomato Price Statistics[a)]

Year	NIPT	NIPM	NIPW	NIPV	USFOB
77	0.4034 (0.0066)[b]	0.3923 (0.0070)	0.4019 (0.0056)	0.4734 (0.0081)	0.2488 (0.0031)
78	0.3565 (0.0648)	0.3602 (0.0071)	0.3662 (0.0053)	0.4040 (0.0657)	0.2346 (0.0031)
79	0.4076 (0.0024)	0.4192 (0.0028)	0.4571 (0.0032)	0.4919 (0.0047)	0.2678 (0.0018)
80	0.3825 (0.0033)	0.4177 (0.0037)	0.4518 (0.0039)	0.4444 (0.0028)	0.2419 (0.0011)
81	0.4958 (0.0334)	0.5227 (0.0369)	0.5752 (0.0335)	0.5759 (0.6321)	0.3041 (0.0179)
82	0.4691 (0.0121)	0.5085 (0.0115)	0.5450 (0.0164)	0.5588 (0.0138)	0.2859 (0.0055)
83	0.5100 (0.0286)	0.5622 (0.0319)	0.6329 (0.0360)	0.5851 (0.0332)	0.3297 (0.0139)
84	0.5028 (0.0133)	0.5237 (0.0124)	0.6421 (0.0238)	0.5967 (0.0162)	0.3599 (0.0099)
85	0.4499 (0.0159)	0.4750 (0.0191)	0.5240 (0.0258)	0.5211 (0.0190)	0.3918 (0.0319)
77-85	0.4499 (0.0159)	0.4750 (0.0191)	0.5240 (0.0258)	0.5211 (0.0190)	0.2961 (0.0118)

[a)] NIPT = Toronto price, NIPM = Montreal price
NIPW = Winnipeg price, NIPV = Vancouver
USFOBC = U.S. f.o.b. price in Canadian dollars

[b)] figures in parentheses are the variances

Table B2

Coefficients of Variations for the Various Prices[a)]

Year	NIPT	NIPM	NIPW	NIPV	USFOB
77	20.175	21.321	18.620	18.987	22.356
78	19.418	23.396	19.796	18.745	23.900
79	12.143	12.552	12.354	13.989	15.814
80	15.054	14.631	13.766	11.891	13.911
81	36.864	36.777	31.819	31.098	44.048
82	23.404	21.119	23.539	21.051	26.044
83	33.170	31.782	29.983	31.161	35.809
84	22.944	21.317	24.011	21.327	27.640
85	24.024	24.471	23.437	29.359	45.578
77-85	27.999	29.089	30.682	26.480	36.705

[a)]NIPT = Toronto price, NIPM = Montreal price
NIPW = Winnipeg price, NIPV = Vancouver
USFOBC = U.S. f.o.b. price in Canadian dollars

Table B3

Test Results for Mean Differences Among Canadian City Price Differentials (T-Values)[a, c]

Year	DPMT[b]	DPMW	DPMV	DPTW	DPTV	DPWV
77	-3.22*	-0.91	-5.06*	0.17	-4.68*	-6.97*
78	0.50	-0.38	-2.74*	-0.65	-3.43*	-4.91*
79	1.58	-3.39*	-4.40*	-4.39*	-5.59*	-2.39*
80	3.54*	-3.38*	-1.75	-7.68*	-4.00*	0.60
81	3.00*	-4.34*	-2.91*	-5.32*	-4.06*	-0.05
82	4.46*	-1.88	-1.81	-4.49*	-3.05*	-0.36
83	5.04*	-6.99*	-0.80	-8.11*	-2.66*	1.51
84	1.57	-3.75*	-3.13*	-6.75*	-4.79*	2.24*
85	3.61*	-3.97*	0.27	-9.31*	-1.13	2.82*
77-85	6.93*	-7.78*	-5.84*	-11.53*	-9.76*	0.34

a)The test hypothesis is H_0; $D_{ijt} = P_{it} - P_{jt} = 0$ and H_A; $D_{ijt} \neq 0$.

b)DP - Stands for price differential and the last two letters stand for the first letter in each city pair names, where
M = Montreal, T = Toronto
W = Winnipeg, V = Vancouver
and for example DPMT is the price differential between prices in Montreal and Toronto.

c)*Significant at the 5 percent level.

Table B4

Tests Results for Mean Differences Between I-TH Canadian City and U.S. F.O.B. Price (T-values)[a]

Year	T-U.S.[b]	M-U.S.	W-U.S.	V-U.S.
77	9.26*	8.56*	9.11*	10.17*
78	10.10*	8.50*	6.91*	9.51*
79	16.16*	19.95*	14.24*	13.80*
80	12.72*	11.61*	14.21*	14.16*
81	7.94*	7.49*	8.17*	8.07*
82	11.30*	13.85*	10.18*	11.29*
83	8.13*	9.58*	11.67*	8.07*
84	10.09*	13.78*	10.06*	12.78*
85	3.55*	5.56*	6.44*	4.41*
77-85	22.88*	24.57*	23.29*	25.34*

a)The test hypothesis is: H_0: $D = P_i - P^{US} = 0$ and H_A: $D \neq 0$.

b)T = Toronto, M = Montreal, W = Winnipeg, V = Vancouver and U.S. is the U.S. f.o.b. price expressed in Canadian dollars.

APPENDIX C

Table C1

Tests for Spatial Market Integration with Montreal as the Central Market[a,b]

	Toronto	Winnipeg	Vancouver
1. Market segmentation	6.1124 (0.0001)	6.0839 (0.0001)	8.7715 (0.0001)
2. Short-run integration	0.6728 (0.7323)	0.6791 (0.7268)	2.2.7066 (0.0083)
3. Long-run integration	0.3217 (0.5722)	0.3424 (0.5600)	15.6089 (0.0002)
4. Local tariff effect	0.8117 (0.3702)	0.0430 (0.8362)	2.1698 (0.1446)
5. Local trend effect	1.6685 (0.2001)	1.2960 (0.2583)	10.9755 (0.0014)
6. Local seasonality effect	0.2144 (0.9958)	0.3576 (0.9680)	1.9715 (0.0417)

a) The marginal significance levels for the F-tests are shown parenthetically.

b) The degrees of freedom for rows (1), (2), (3) are F(5,80), F(9,80) and F(1,80) respectively. Rows (4) and (5) are F(1,80) and row (6) is distributed as F(11,80).

Table C2

Tests for Spatial Market Integration with Winnipeg as the Central Market[a, b]

	Montreal	Toronto	Vancouver
1. Market segmentation	4.1217 (0.0023)	4.8655 (0.0001)	6.7816 (0.0001)
2. Short-run integration	0.9316 (0.5031)	0.9248 (0.5089)	1.7365 (0.0933)
3. Long-run integration	0.0844 (0.7721)	0.3183 (0.5089)	5.1577 (0.0933)
4. Local tariff effect	1.9962 (0.1615)	0.0437 (0.5135)	0.5474 (0.4615)
5. Local trend effect	1.4764 (0.4920)	1.2978 (0.5867)	4 6629 (0.0337)
6. Local seasonality effect	0.6222 (0.8057)	0.2659 (0.9898)	1.7768 (0.6629)

a) The marginal significance levels for the F-tests are shown parenthetically.

b) The degrees of freedom for rows (1), (2), (3) are F(5,80), F(9,80) and F(1,80) respectively. Rows (4) and (5) are F(1,80) and row (6) is distributed as F(11,80).

Table C3

Tests for Spatial Market Integration with Vancouver as the Central Market[a,b]

	Montreal	Toronto	Winnipeg
1. Market segmentation	3.7122 (0.0046)	5.0417 (0.0005)	5.2419 (0.0004)
2. Short-run integration	2.7471 (0.0075)	0.9949 (0.0040)	2.4506 (0.0160)
3. Long-run integration	9.7585 (0.0025)	10.9728 (0.0014)	5.5363 (0.0027)
4. Local tariff effect	2.4119 (0.1586)	1.3661 (0.3759)	0.0522 (0.0046)
5. Local trend effect	2.0240 (0.1586)	1.7928 (0.3759)	8.4858 (0.0046)
6. Local seasonality effect	0.7373 (0.0792)	0.9570 (0.4921)	1.5614 (0.8549)

a) The marginal significance levels for the F-tests are shown parenthetically.

b) The degrees of freedom for rows (1), (2), (3) are F(5,80), F(9,80) and F(1,80) respectively. Rows (4) and (5) are F(1,80) and row (6) is distributed as F(11,80).

APPENDIX D

TABLE D1

Structural Estimates for Montreal[a, b)]

	RPIMPT	IMPORTS
INTERCEPT	1.6156(9.479)	16.5395(0.470)
RPIMPTL	0.2006(3.297)	-
RFOBUS	0.6748(13.480)	-
EXRATE	1.1360(4.863)	-
TARIFF	1.0647(3.003)	-
RATIO	0.6748(13.480)	-
CPIC	-0.3252(6.497)	-
RPIMPT	-	-0.1127(0.731)
IMPORTSL	-	0.1979(1.985)
RWWAGES	-	0.1979(1.985)
TYPOPN	-	0.8045(0.592)
TPOPN	-	-1.1461(0.315)
RVPINDX	-	-1.6319(3.812)
TPOPN	-	-1.1461(0.315)
RVPINDX	-	-1.6319(3.812)
DUM 1	-	0.1037(0.682)
DUM 2	-	0.1037(0.682)
DUM 3	-	-0.0071(0.045)
DUM 4	-	0.1459(0.915)
DUM 5	-0.1013(1.616)	0.2853(1.921)
DUM 6	-0.1055(1.766)	0.1695(1.118)
DUM 7	-0.0033(0.056)	0.1969(1.229)
DUM 8	-0.1184(1.947)	-1.0349(6.930)
DUM 9	-0.0751(1.218)	-1.6045(8.029)
DUM 10	-0.0296(0.487)	-0.9727(4.656)
DUM 11	-0.0251(0.149)	
DW	1.816	2.003

Continued

Table D1 (Continued)

System Statistics

	RPIMPT	IMPORTS
Σ =	0.0171	-0.0010
	-	0.0937

Weighted MSE = 0.999
Weighted R^2 = 0.752

[a]The reported estimates refer to the dynamic version.
[b]Absolute t-values in parentheses.

Table D2

Structural Estimates for Toronto[a, b)]

	RPIMPT	IMPORTS
INTERCEPT	1.5045(8.956)	-40.3008(1.078)
RPIMPTL	0.1595(2.770)	-
RFOBUS	0.7024(14.335)	-
EXRATE	1.8394(3.611)	-
TARIFF	1.6454(1.893)	-
RATIO	0.7024(14.335)	-
CPIC	-0.2976(6.074)	-
RPIMPT	-	-0.5466(4.460)
IMPORTSL	-	0.0786(0.819)
RWWAGES	-	0.18330(0.925)
TYPOPN	-	0.0849(1.396)
TPOPN	-	4.0849(0.396)
RVPINDX	-	-0.0048(0.011)
TPOPN	-	-4.0849(0.396)
RVPINDX	-	-1.6319(3.812)
DUM1	-	0.0651(0.512)
DUM2	-	0.1523(1.179)
DUM3	-	0.1716(1.317)
DUM4	-	0.2695(1.953)
DUM 5	-0.0329(0.541)	0.3529(2.684)
DUM 6	-0.0546(0.950)	0.1959(1.362)
DUM 7	-0.0266(0.460)	0.2454(1.705)
DUM 8	-0.0313(1.533)	-1.8112(6.221)
DUM 9	-0.0377(0.638)	-1.6756(4.588)
DUM 10	-0.0361(0.620)	-0.2714(1.913)
DUM 11	-	-0.0062(0.050)
DW	2.008	2.117

Continued

Table D2 (Continued)

System Statistics

		RPIMPT	IMPORTS
	Σ =	| 0.0158	0.0016 |
		| -	0.0635 |

Weighted MSE = 0.9996
Weighted R^2 = 0.7623

[a]The reported estimates refer to the dynamic version.
[b]Absolute t-values in parentheses.

Table D3

Structural Estimates for Winnipeg[a, b)]

	RPIMPT	IMPORTS
INTERCEPT	1.8259(9.548)	0.5799(0.033)
RPIMPTL	0.3147(4.511)	-
RFOBUS	0.6172(10.882)	-
EXRATE	1.7552(6.999)	-
TARIFF	1.5288(1.668)	-
RATIO	0.6172(10.882)	-
CPIC	-0.3827(6.748)	-
RPIMPT	-	-0.0.3955(4.217)
IMPORTSL	-	0.24878(2.439)
RWWAGES	-	1.4771(1.180)
TYPOPN	-	-0.0518(0.028)
RVPINDX	-	-0.6057(1.536)
DUM1	-	0.0593(0.676)
DUM2	-	0.0.100(0.114)
DUM3	-	0.0865(0.980)
DUM4	-	0.2645(2.933)
DUM5	-0.0095(0.153)	0.4404(4.938)
DUM6	-0.0129(0.215)	0.3663(3.612)
DUM7	-0.0292(0.484)	0.5682(5.616)
DUM8	-0.0039(0.065)	0.2561(2.394)
DUM9	-0.0187(0.303)	-0.4595(5.287)
DUM10	-0.0014(0.022)	-0.4349(4.504)
DUM11	-	-0.0859(0.980)
DW	1.916	2.003

Continued

Table D3 (Continued)

System Statistics

		RPIMPT	IMPORTS
Σ	=	0.0221	0.0014
		-	0.0311

Weighted MSE = 0.9992
Weighted R^2 = 0.6695

[a] The reported estimates refer to the dynamic version.
[b] Absolute t-values in parentheses.

Table D4

Structural Estimates for Vancouver[a, b)]

	RPIMPT	IMPORTS
INTERCEPT	1.2119(12.100)	4.9509(0.838)
RPIMPTL	0.2296(3.191)	-
RFOBUS	0.5454(9.738)	-
EXRATE	0.7837(2.869)	-
TARIFF	1.6796(2.121)	-
RATIO	0.5454(9.738)	-
CPIC	-0.4545(8.115)	-
RPIMPT	-	-0.2188(2.283)
IMPORTSL	-	0.1924(1.915)
RWWAGES	-	-1.7415(1.851)
TYPOPN	-	-0.0398(1.915)
RVPINDX	-	-0.2624(0.828)
DUM1	-	0.1623(1.763)
DUM2	-	0.3743(4.210)
DUM3	-	0.4663(5.099)
DUM4	-	0.5119(5.504)
DUM5	-0.0068(0.111)	0.4298(4.592)
DUM6	-0.0364(0.603)	0.1172(1.268)
DUM7	-0.1387(2.287)	0.2985(3.287)
DUM8	-0.0709(1.170)	0.4184(4.613)
DUM9	-0.1648(2.68 3)	0.1428(1.502)
DUM10	-0.1077(1.756)	0.1375(1.502)
DUM11	-	-0.1858(2.085)
DW	2.056	2.024

Continued

Table D4 (Continued)

System Statistics

	RPIMPT	IMPORTS
Σ =	0.0219	0.0025
	-	0.0351

Weighted MSE = 0.9975
Weighted R^2 = 0.6311

[a] The reported estimates refer to the dynamic version.
[b] Absolute t-values in parentheses.

Table D5

Structural Estimates of the Model for West-Central[a)]

	RPIMPT	IMPORTS
INTERCEPT	1.7817(19.555)	-2.1478(2.074)
RPIMPTL	0.2521(7.856)	-
RFOBUS	0.6267(23.346)	-
EXRATE	0.1877(9.556)	-
TARIFF	0.7260(4.392)	-
RATIO	0.6267(23.346)	-
CPIC	-0.3733(13.908)	-
RPIMPT	-	-0.3027(4.073)
IMPORTSL	-	0.2091(4.479)
RWWAGES	-	0.7034(3.863)
TYPOPN	-	-0.5421(14.165)
RVPINDX	-	-0.6209(2.937)
DUM1	-	0.0716(0.937)
DUM2	-	0.1739(2.307)
DUM3	-	0.1557(2.039)
DUM4	-	0.2846(3.691)
DUM 5	-0.0422(1.366)	0.3292(4.395)
DUM 6	-0.0500(1.678)	0.1292(1.679)
DUM 7	-0.0347(1.160)	0.2998(3.888)
DUM 8	-0.0555(1.838)	-0.3665(4.872)
DUM 9	-0.0718(2.350)	-0.5389(7.045)
DUM 10	-0.0206(0.682)	-0.1776(2.232)
DUM 11	-	-0.1269(1.686)
REG1[b)]	0.0877(6.151)	-
DW	1.906	2.001

Continued

Table D5 (Continued)

System Statistics

		RPIMPT	IMPORTS
Σ =		0.0198	0.0006
		-	0.0963

Weighted MSE = 0.999
Weighted R^2 = 0.780

[a] t-values are shown parenthetically.

[b] test statistic for H_0:REG1 = 0, is 37.842 with F(1,827), REG1 takes on a value of one if an observation falls within western Canada; otherwise zero (i.e., observations for Winnipeg and Vancouver are classified as being in western Canada and, Toronto and Montreal in central Canada.

APPENDIX E

Table E1

Rail Distance (Miles)[a]

	M	T	W	V
M	-	?	1,409	2,883
T		-	1,217	2,776
W			-	1,474[b]
V				-

Distance Source: Via Rail Canada.

[a]Computed as the Montreal-Vancouver minus Montreal Winnipeg.
[b]M=Montreal, T=Toronto, W=Winnipeg, and V=Vancouver.

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