Exchange Rate Pass-through in Canadian Manufacturing: Its Direct and Indirect Components

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Running Title: Direct and indirect pass-through

Abstract: Changes in the exchange rate have direct and indirect effects on the prices of domestically produced goods and imports in the domestic market. The direct effects originate with the impact of the exchange rate on the marginal cost of imports; the indirect effects, with its impact on the price of materials used by domestic producers and hence on their marginal costs. Direct and indirect exchange rate pass-through elasticities are estimated for thirty-seven Canadian manufacturing industries and their determinants are examined in a cross-section analysis. We find that the direct and indirect elasticities are approximately equal in size for domestic goods, while the direct effect is dominant for imports. For a small number of industries, the net result of the direct and indirect effects is that a depreciation of the domestic currency increases the competitiveness of imports, contrary to conventional analysis. Important determinants of the direct (indirect) elasticities are the import share and non-tariff barriers (the responsiveness of domestic costs to changes in the exchange rate, and concentration).

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1. Introduction

In recent years, the demise of the Bretton Woods agreement and the development of models of international trade with imperfect competition have led researchers to examine empirically how product prices respond to fluctuations in exchange rates.[1] In an interesting paper, Feinberg (1989) studied the industry determinants of exchange rate pass-through into domestic prices for the U.S. Subsequently, Yang (1997) and Lee (1997) examined the pass-through into import prices for the U.S. and Korea, respectively. More recently, we (Kardasz and Stollery 2001) dealt with pass-through into both prices for a broad sample of Canadian manufacturing industries. Using a two-stage procedure, we first estimated pass-through elasticities by regressing domestic and import prices against the exchange rate and a number of control variables, the most important of which is the price in the matching U.S. industry or industries. Based on annual data for the period from 1971 to 1989, estimates of the elasticities were obtained for thirty-one industries at the L-level (essentially the three- or four-digit SIC level) of industry aggregation. The inter-industry variation in these elasticities was then examined in a cross-section analysis.

The present study extends our earlier work by dividing the total effects of exchange rate changes on domestic and import prices into two components, which we call the direct and indirect effects. In a model where domestic and import prices are simultaneously determined, the direct effects occur because the exchange rate is a determinant of the marginal cost of imports, expressed in domestic currency. The indirect effects, on the other hand, originate with the impact of the exchange rate on the prices of both domestically produced and imported materials used by domestic producers, and hence on their marginal costs.

This paper was motivated by a finding in our earlier study which proved to be robust, namely, that the (total) domestic pass-through elasticity increases across industries with a variable measuring the responsiveness of domestic costs to the exchange rate. This result suggests that the exchange rate has a significant indirect effect on domestic prices in at least some Canadian manufacturing industries. However, it does not provide any indication of the relative sizes of the direct and indirect effects.

The distinction between these two effects is important. To see why, consider a depreciation of the domestic currency. This causes both domestic and import prices to increase. As one might expect, the direct effect of the depreciation is larger for imports whereas the indirect effect is larger for domestic goods. Since this is the case, the depreciation has two effects on the competitiveness (i.e., relative price) of imports in the domestic market which work in opposite directions: it makes imports less competitive because of the direct effects, and more competitive because of the indirect effects. The net result depends on how these two opposing tendencies are resolved.

The rest of this paper is organized as follows. In section 2 we present a simple conceptual framework. In section 3 we describe the estimation at the industry level of a three-equation model which yields separate estimates of the direct and indirect pass-through elasticities for both domestic and imported goods. In section 4 we attempt to explain the inter-industry variation in these elasticities. Our conclusions appear in section 5.

2. A Simple Conceptual framework

We assume that international arbitrage is not possible and that unit costs do not vary with output. These assumptions allow the behaviour of firms in the domestic market to be examined in isolation. In addition, we imagine that the prices of domestic and foreign goods in this market (P_d and P_m) are determined by representative domestic and foreign firms whose products are differentiated.

The profit functions (in domestic currency) of the representative firms are

$$\pi_i = (P_i - C_i) \bullet Q_i\,(P_d\,,\,P_m,\,P,\,Y) \quad \text{for } i = d,m \tag{1}$$

where Q_i ( ) represents the demand functions, P is the general price level (the price of "all other" goods), and Y is nominal income. C_d, the unit cost of domestic producers, depends on the price of their material inputs (P_{mat}) and this, in turn, depends on E, the nominal exchange rate (the domestic currency price of foreign currency), i.e., $C_d = C_d\,(P_{mat}\,(E))$. For simplicity, other determinants of P_{mat} and C_d are suppressed until the following section. In contrast, C_m , the unit cost of imports, equals EC_m^* , where C_m^* is the unit cost of foreign firms in foreign currency.

Given the assumption that the demand functions are homogeneous of degree zero, we can perform the rest of the analysis in terms of real prices, costs and income. The best-response functions of the two firms can be written as

$$p_d = p_d\,(p_m\,,\, c_d\,(p_{mat}\,(e))\,,\, y) \tag{2}$$

and

$$p_m = p_m\,(p_d\,,\, e\,, c_m^*\,,\, y) \tag{3}$$

where p_d , p_m , p_{mat} and y represent the corresponding nominal variables deflated by P, e is the real exchange rate defined as EP* / P where P* is the foreign price level in foreign currency, and $c_m^* = C_m^* / P^*$.

A change in e has direct effects on both p_d and p_m which originate with the response of p_m to e in equation (3). In contrast, the indirect effects arise from the impact of e on p_{mat} and thereby p_d in equation (2). Using Cramer's rule, the total effects of a change in e on both prices can be written in terms of elasticities as follows:

$$\begin{aligned} \epsilon_{de} &= \frac{1}{A}\,\frac{\partial \ln p_d}{\partial \ln p_m}\,\frac{\partial \ln p_m}{\partial \ln e} + \frac{1}{A}\,\frac{\partial \ln p_d}{\partial \ln p_{mat}}\,\epsilon_{mate} \\ &= \epsilon_{dD} + \epsilon_{dI} \end{aligned} \tag{4}$$

and

$$\begin{aligned} \epsilon_{me} &= \frac{1}{A}\,\frac{\partial \ln p_m}{\partial \ln e} + \frac{1}{A}\,\frac{\partial \ln p_m}{\partial \ln p_d}\,\frac{\partial \ln p_d}{\partial \ln p_{mat}}\,\epsilon_{mate} \\ &= \epsilon_{mD} + \epsilon_{mI} \end{aligned} \tag{5}$$

where $\epsilon_{de} = d \ln p_d / d \ln e$, $\epsilon_{me} = d \ln p_m / d \ln e$, $\epsilon_{mate} = \partial \ln p_{mat} / \partial \ln e$, and $A = 1 - (\partial \ln p_d / \partial \ln p_m)(\partial \ln p_m / \partial \ln p_d)$. Equations (4) and (5) divide the total pass-through elasticities, ϵ_{de} and ϵ_{me}, into their direct (D) and indirect (I) components. The (Bertrand) equilibrium in our model will be unique and stable if $1/(\partial \ln p_d / \partial \ln p_m) > \partial \ln p_m / \partial \ln p_d$, a condition that is satisfied when both partial derivatives are less than one. Given this condition, it follows that $\epsilon_{mD} > \epsilon_{dD}$ and that $\epsilon_{dI} > \epsilon_{mI}$.

3. Estimation of the pass-through elasticities

There are four differences in specification between the simplified model presented in the previous section and the one we estimate empirically. First, in order to obtain industry estimates of ϵ_{mate} , we add a third equation in which p_{mat} is assumed to depend on e and two control variables, y and the price of materials in matching U.S. industries (p_{matu}). Second, c_d is assumed to depend not only on p_{mat} but also on the real wage rate (w) and an index of total factor productivity (tfp). Third, because of limitations in the available data, the price of domestically produced goods in the domestic market (p_d) is replaced by the price of all domestically produced goods including exports ($\tilde{p}_d$). Finally, the impact of income on pricing is measured by y_{err} , the trend-free residual obtained when the first difference in the logarithm of real GDP is regressed against time and time squared. This variable is intended to capture the effects of the business cycle on pricing.

Our data set covers the period from 1961 to 1995 for seventy-three L-level industries in the Canadian manufacturing sector.[2] The variables used in the empirical analysis, along with their sources, are shown in Table 1.

We express all price, cost and productivity variables (p_d , p_m, p_{mat}, e, w, tfp, c_{US} and p_{matu}) as natural logarithms. Prior to estimation, these variables were checked for unit roots using Phillips-Perron tests. For most of the variables, the null hypothesis of a unit root could not be rejected at the conventional 5% level of significance. Consequently, we differenced the data, and then checked for stationarity using the KPSS (Kwiatkowski et al, 1992) test with stationarity as the null. The one industry (office, store and business machine industry) which failed this test was deleted from our data set.

Assuming that the price equations to be estimated are linear, they can be written as follows:

$$\Delta \ln \tilde{p}_d = \alpha_0 + \alpha_1 \Delta \ln p_m + \alpha_2 \Delta \ln p_{mat} + \alpha_3 \Delta \ln w + \alpha_4 \Delta \ln tfp + \alpha_5 y_{err} \qquad (6)$$

$$\Delta \ln p_m = \beta_0 + \beta_1 \Delta \ln \tilde{p}_d + \beta_2 \Delta \ln e + \beta_3 \Delta \ln c_{US} + \beta_4 y_{err} \qquad (7)$$

$$\Delta \ln p_{mat} = \gamma_0 + \gamma_1 \Delta \ln e + \gamma_2 \Delta \ln p_{matu} + \gamma_3 y_{err} \qquad (8)$$

A priori, we expect α_1 , α_2, α_3, β_1 , β_2 , β_3 , γ_1 and γ_2 to be positive and α_4 to be negative. We have no sign expectation for the coefficients on y_{err} because some real prices may rise during upswings in economic activity ($y_{err} > 0$) and fall during downswings ($y_{err} < 0$), while others may do the reverse.

Equations (6) and (7), which satisfy the rank and order conditions for identification, were estimated using 2SLS with the lagged exogenous variables as instruments. Equation (8), on the other hand, was estimated using OLS.[3] Since unit root tests have low power and since differencing a stationary series creates an MA(1) component (Maddala and Kim, 1998, p.13), the price equations were estimated allowing for MA(1) errors.

Given that the same regressions were run for all seventy-two industries, it is perhaps not surprising that the results we obtained were quite mixed. In an attempt to deal with this problem, we developed a set of criteria to be used in deciding which industries to retain for further analysis. An industry was dropped if one or more of the following conditions were met: (1) the estimated values of α_1 and/or β_1 for that industry exceeded one; (2) any of its coefficients for which we have a definite sign expectation (α_1 , α_2 , α_3 , α_4 , β_1 , β_2 , β_3 , γ_1 and γ_2) turned out to have an unexpected sign and was statistically different from zero at the 5% level, one-tailed test; and (3) any of its price equations had an adjusted R^2 that was zero or negative. In addition, we dropped two industries (cane and beet sugar, and jewellery and precious metals) where the estimated values of γ_2 seemed to be implausible (3.019 and 2.191, respectively) and one industry (signs and displays) where not all of required cross-section data were available. The end result was that thirty-five industries were dropped, leaving thirty-seven for further analysis.

While the large number of industries that had to be dropped represents a weakness of our approach, it has the compensating benefit of improving the quality of the estimates of the various pass-through elasticities. Furthermore, it highlights the need for additional studies to deal with the complexities of the industries which had to be deleted.

The price equations for the industries which were retained are reported in Appendix Tables 1, 2 and 3. The corresponding pass-through elasticities, are presented in Table 2. $\hat{\alpha}_1$ is negative but insignificant in three industries (meat and meat products, veneer and plywood, and sash, door and other millwork), as is $\hat{\beta}_1$ (fruit and vegetables, copper rolling, casting and extruding, and hardware, tools and cutlery). These coefficients were set equal to 0 for the purposes of calculating the pass-through elasticities for these industries.

Table 2 can be used to determine how and to what extent a real depreciation of the domestic currency is expected to affect the competitiveness of imports in the domestic market. To illustrate, we can consider the two extreme cases in that table: aluminum rolling, casting and extruding, and meat and meat products. From Table 2, it follows that a 1% depreciation of the domestic currency will lead to a 1.018% increase in the relative price of imports in the aluminum industry and to a decrease of 0.105% in the meat industry. Thus, it appears that a depreciation makes aluminum imports less competitive and – contrary to conventional analysis – meat imports more competitive.

The explanation for this difference is to be found in the direct and indirect effects for these industries. To see this, let $X = p_m / p_d$. $d \ln X / d \ln e = d \ln p_m / d \ln e - d \ln p_d / d \ln e = (\epsilon_{mD} + \epsilon_{mI}) - (\epsilon_{dD} + \epsilon_{dI}) = (\epsilon_{mD} - \epsilon_{dD}) - (\epsilon_{dI} - \epsilon_{mI})$. Since the last two bracketed terms are both positive, a real depreciation of 1% causes the relative price of imports to increase by an amount equal to the gap between the direct elasticities, $(\epsilon_{mD} - \epsilon_{dD})$ and to decrease by an amount equal to the gap between the indirect elasticities, $(\epsilon_{dI} - \epsilon_{mI})$. For the aluminum industry, the gaps equal

1.117 and 0.100, respectively. In contrast, they equal 0.060 and 0.165 for the meat industry.

Summary statistics and frequency distributions relating to the pass-through elasticities appear in Table 3. The average values of the direct and indirect elasticities are 0.162 and 0.140 for domestic goods and 0.564 and 0.067 for imports. These values imply that, on the average, a real depreciation makes imports less competitive because the gap between the direct elasticities (0.402) exceeds the gap between the indirect elasticities (0.073). At the same time, however, there are four industries in our sample (meat and meat products, footwear, miscellaneous leather products, and non-ferrous metals smelting and refining) where imports are made more competitive by a depreciation.

For domestic goods, the frequency distributions of the direct and indirect elasticities are quite similar, with over 85% of both elasticities having values less than 0.4. In contrast, for imports, about 78% of the direct elasticities exceed 0.4 while 86% of the indirect elasticities are less than 0.1. In sum, Table 3 shows that, at least for our sample of thirty-seven industries, the direct and indirect effects of exchange rate changes are about of equal importance for domestic goods, whereas the direct effect is clearly dominant for imports.

When combined, the direct and indirect elasticities yield average total pass-through elasticities of 0.302 for domestic goods and 0.631 for imports. These values are more than double those obtained in our early study (0.125 and 0.255, respectively). At least three factors may have contributed to this result: (1) the estimates in the present study are based on a longer time period (1963-95 versus 1972-89); (2) only eighteen industries out of a total of thirty-one in the previous paper and thirty-seven in the current one are common to both studies; and (3) the equations that were estimated and the econometric methods employed in the two studies are quite different. Despite these differences, both studies are consistent with the following generalizations: (1) the average total pass-through elasticity is considerably larger (about twice as large) for imports than for domestic goods; (2) incomplete pass-through is the norm for both domestic goods and imports – although there are three exceptions to this generalization for imports in the present study, as can be seen from Table 2; and (3) pass-through into domestic and import prices varies substantially across industries.

4. Determinants of the pass-through elasticities

For our sample of thirty-seven Canadian manufacturing industries, the simple correlations between the direct and indirect elasticities are -0.196 for domestic goods and -0.353 for imports. These low correlations support the view that (our estimates of) the direct and indirect elasticities are distinct variables that should be examined separately. However, to facilitate comparison with earlier studies, we also analyze the determinants of the total domestic and import elasticities.

The independent variables are listed in Table 1. They include three elements of market structure which are standard for an open economy like Canada's: concentration, which we measure by the Herfindahl index (H); the (domestic) tariff (TF), which we supplement by a dummy variable (NTB) to take account of non-tariff barriers; and product differentiation. To these variables, we add the import share (MSR) and a regional dummy variable (REGD). As argued by Feinberg (1989, 507), Yang (1997, 96-97) and Kardasz and Stollery (2001, 730-31), the import share is an observable variable which influences the demand elasticities of domestic and foreign firms and thereby the pass-through elasticities. We use REGD to proxy natural barriers to trade since markets become localized when transport costs and related factors such as product perishability are sufficiently important to limit the area served by a producing entity.

Estimates of the elasticity of substitution between domestically produced and imported goods in the Canadian market have been calculated by Létourneau and Lester (1988). Conceptually, this variable appears to be a good measure of product differentiation for the purposes of this study. Unfortunately, it is available for only about twenty of the thirty-seven industries in our sample. In empirical studies of industrial organization, it is common to proxy product differentiation by the advertising-sales ratio. However, this practice appears to be questionable, given that advertising expenditures depend not only on the extent of product differentiation but also on other factors such as price-cost margins and, in the case of oligopolistic industries, strategic considerations. In the end, we decided to measure product differentiation by a dummy variable (PDIF) which is based on the industry taxonomy developed by the OECD and employed by Baldwin and Rafiquzzaman (1995).

All of the explanatory variable discussed so far apply to all three foreign elasticities and to the domestic elasticities, provided they refer to the prices of domestically produced goods sold in the domestic market (p_d). However, as noted earlier, the available data, and hence the domestic pass-through elasticities which we have estimated, refer to the prices of domestically produced goods whether sold at home or abroad ($\tilde{p}_d$). $\tilde{p}_d$ can be viewed as being a weighted average of p_d and the export price (p_x), both of which are unobserved, with the weights depending on the export share (x):

$$\tilde{p}_d = (1\text{-}x)\ p_d + x\ p_x\ .$$

For this reason, we add the export share (XSR) as a determinant of the (observed) domestic elasticities since there is no reason to expect the exchange rate effects on p_d and p_x to be equal.

From equations (4) and (5), it can be seen that the indirect elasticities (ϵ_{dI} and ϵ_{mI}) depend on the responsiveness of the price of materials to the exchange rate (ϵ_{mate}) and on the responsiveness of the domestic price to the price of materials ($\partial \ln p_d / \partial \ln p_{mat}$). To take account of these two factors, we include the estimated value of ϵ_{mate} and the (domestic) ratio of materials to the value of output (MASR) as determinants of the indirect and total elasticities.

Linear and, as described below, non-linear versions of the six pass-through elasticity equations were estimated using OLS with the HETCOV option in the SHAZAM econometrics software package. This option corrects the standard errors of coefficients for heteroskedasticity using White's heteroskedastic-consistent covariance matrix.

As can be seen from equations (4.1) and (4.7), there is a significant inverse relationship between the two direct elasticities ($\hat{\epsilon}_{dD}$ and $\hat{\epsilon}_{mD}$), on the one hand, and MSR and NTB, on the other. In addition, $\hat{\epsilon}_{dD}$ increases with PDIF, while $\hat{\epsilon}_{mD}$ increases with H and decreases with REGD.

Some years ago, Harry Bloch (1974) found that the effects of concentration and the tariff on prices in Canadian import-competing industries are interdependent. For this reason, we added the interactive term H*TF to the list of explanatory variables for both the direct and indirect elasticities. However, as can be seen from (4.2) and (4.8), this variable proved to be insignificant in the equations for the direct elasticities.

In our preferred regressions for the indirect elasticities ($\hat{\epsilon}_{dI}$ and $\hat{\epsilon}_{mI}$), $\hat{\epsilon}_{mate}$ and MASR enter multiplicatively, a specification which seems to be consistent with the chain of causation associated with the indirect effects. The determinants of the indirect elasticities in equations (4.4) and (4.10) are quite similar. Specifically, the coefficients on H, TF, H*TF, NTB, PDIF and $\hat{\epsilon}_{mate}$ *MASR all have the same signs and are statistically significant in both equations. In fact, the only material differences between these equations occur with respect to REGD, whose coefficient is significant only in (4.10).

In these equations, the derivatives of $\hat{\epsilon}_{dI}$ and $\hat{\epsilon}_{mI}$ with respect to H increase with TF and they are negative when TF is less than 9.26 and 9.59, respectively, and positive when TF exceeds these values. Since TF is less than 9.26 in twenty-eight (76%) of the industries in our sample and less than 9.59 in thirty-two (86%), it follows that increases in concentration lower the indirect elasticities in most – but not all – of our industries. Similarly, the derivatives with respect to TF increase with H and they are negative when H is less than 0.118 and 0.110, respectively, and positive when it is greater than these values. Given the distribution of our industries with respect to H, it follows that a tariff increase will lower the indirect elasticities in twenty-one industries

(57% of the total).

In order to facilitate comparison with earlier studies, we now turn to the regression results for the total elasticities ($\hat{\epsilon}_{de}$ and $\hat{\epsilon}_{me}$). Not surprisingly, the present paper is most closely related to our 2001 study. However, it is also related to those by Feinberg (1989), Yang (1997) and Lee (1997) referred to in the introduction to this paper.

Our earlier study leads to three tentative conclusions. Using our current notation, the first is that $\hat{\epsilon}_{de}$ increases with $\hat{\epsilon}_{mate}$ * MASR and XSR. The present paper is consistent with that result and also with Feinberg's conclusion that the exchange rate has a larger impact on domestic prices in U.S. manufacturing industries with a heavy reliance on imported inputs. The second conclusion of our earlier study is that $\hat{\epsilon}_{me}$ increases with the rate of price protection, and the import share. In contrast, in equation (4.12), $\hat{\epsilon}_{me}$ decreases with MSR while the coefficient on TF is insignificant. The third conclusion is that the impacts on $\hat{\epsilon}_{de}$ and $\hat{\epsilon}_{me}$ of two variables which have been used to measure product differentiation, the elasticity of substitution between imported and domestic goods and the advertising-sales ratio, are not robust. The present study provides a plausible explanation for this finding: since PDIF affects the direct and indirect elasticities in opposite directions, a variety of results become possible when total effects are considered, depending on equation specification and industry sample.

Feinberg (1989) finds that the changes in the exchange rate have smaller effects on domestic prices in U.S. manufacturing industries which are capital intensive. When the capital-output ratio (KQR) is added to our regressions for the domestic elasticities, we find that is a significant determinant of the direct elasticity ($\hat{\epsilon}_{dD}$), though not of the other elasticities ($\hat{\epsilon}_{dI}$ and $\hat{\epsilon}_{de}$). However in contrast to Feinberg, our results indicate that capital intensity has a positive effect on $\hat{\epsilon}_{dD}$.

Yang (1997) and Lee (1997) analyze the determinants of the total import elasticity for U.S. and Korean manufacturing, respectively. Yang finds that this elasticity decreases with the capital-to-labour ratio. However, we find that this variable (KLR) is not significant in any of our regressions for the import elasticities. In contrast to Lee's main result is that concentration reduces the total import elasticity, we find in equations (4.7) and (4.11) that the direct and total import elasticities increase with H. However, consistent with Lee, it appears from (4.10) that the indirect import elasticity decreases with H for most (86%) of the industries in our sample.

5. Conclusions

In this paper, we have emphasized the distinction between the direct and indirect effects of changes in the exchange rate on the prices of domestically produced and imported goods. We have argued that this distinction is important because the two effects have opposite implications for how the competitiveness of imports responds to changes in the exchange rate.

We estimated direct and indirect elasticities for thirty-seven Canadian manufacturing industries and we examined the inter-industry variation in these elasticities in a cross-section analysis. Our empirical analysis leads to the following conclusions. First, the direct and indirect pass-through elasticities are roughly equal in size for domestic goods, while the direct effect is dominant for imports. Second, while the conventional view that a depreciation of the domestic currency makes imports less competitive seems to hold for most of the thirty-seven industries in our (usable) sample, there are four industries where the reverse appears to be the case. The exceptions occur where the gap between the indirect effects for domestic goods and imports exceeds the gap between their direct effects in absolute value. Third, industry values of the domestic and import direct elasticities decrease with the import share and non-tariff barriers. Fourth, the domestic direct elasticity tends to be high in industries where product differentiation is significant whereas the two indirect elasticities tend to be low. Fifth, the indirect elasticities increase with the responsiveness of domestic costs to changes in the exchange rate, as measured by the elasticity of the price of materials used by domestic producers with respect to the exchange rate times the share of materials in the value of output. Sixth, the relationships between the indirect elasticities, on the one hand, and concentration and the tariff, on the other, appear to be somewhat complex. Specifically, our results indicate that the derivatives of the indirect elasticities with respect to concentration (the tariff) increase with the tariff (concentration) and that they are negative when the tariff (concentration) is low and positive when it is high. Seventh, studies dealing with total pass-through elasticities combine two effects whose correlation across industries appears to be low and whose determinants seem to be quite different.

Acknowledgement

We wish to thank James Brox, Joseph DeJuan and Tony Wirjanto for their helpful comments and suggestions.

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TABLE 1
Variables used in the empirical analysis

Price equations

$\tilde{P}_{d_{jt}}$	Implicit price index for gross output, 1981=1[a]
$P_{m_{jt}}$	Implicit price index for imports, 1981=1[a]
$P_{mat_{jt}}$	Implicit price index for intermediate inputs, 1981=1[a]
W_{jt}	Compensation per person hour, 1981= 1[a]
$C_{US_{jt}}$	(Payroll + cost of materials in current dollars)/real gross output in matching U.S. industries, 1981=1. Real gross output = (shipments + Δ inventories in current dollars)/price of shipments [b]
$P_{matu_{jt}}$	Cost of materials in current dollars/real gross output in matching U.S. industries, 1981=1 [b]
P_t	GDP deflator for Canada, 1981[c]
P_{US_t}	GDP deflator for the U.S., 1981=1[d]
E_t	Canadian dollars per U.S. dollar, average of noonday rates [c]
$\tilde{P}_{d_{jt}}$	Equals $\tilde{P}_{d_{jt}} / P_t$
$P_{m_{jt}}$	Equals $P_{m_{jt}} / P_t$
$P_{mat_{jt}}$	Equals $P_{mat_{jt}} / P_t$
w_{jt}	Equals W_{jt} / P_t
$c_{US_{jt}}$	Equals $C_{US_{jt}} / P_{US_t}$
$P_{matu_{jt}}$	Equals $P_{matu_{jt}} / P_{US_t}$
tfp_{jt}	Fisher Ideal Indexes of multifactor productivity based on gross output, 1981 = 1[c]
e_t	Equals $E_t P_{US_t} / P_t$
y_t	Index of real GDP, 1981= 1[c]
Y_{err_t}	Trend-free residual obtained by regressing the first difference of $\ln y_t$ against time and time squared

Cross-section equations

H_j Herfindahl index of concentration for 1980, value of shipments [e]

TF_j Tariff rate, circa 1987 [f]

NTB_j Equals 1 for the distilleries, 0 otherwise [f]

MSR_j Imports/Canadian market, 1981 [a]

XSR_j Exports / shipments, 1981 [a]

$PDIF_j$ Equals 1 for industries where product differentiation is high, 0 otherwise [g]

$REGD_j$ Equals 1 for industries with regional markets, 0 otherwise [h]

$MASR_j$ Ratio of materials to the value of output, 1981 [a]

KQR_j Ratio of net capital stock to gross output, 1981 [i]

KLR_j Ratio of net capital stock to number of employees, 1981 [i]

NOTES

All variables refer to Canada unless otherwise specified. The subscripts *t* and *j* index time and industries, respectively.
Canadian and U.S. industries were matched using Statistics Canada and the U.S. Bureau of the Census, *Concordance Between the Standard Industrial Classifications of Canada and the United States, 1980 Canadian SIC - 1987 United States SIC.*

SOURCES

a Input-Output Division, Statistics Canada.

b Bureau of the Census, dBase III+ data files; Bureau of Labour Statistics, Public Database.

c CANSIM Database.

d Council of Economic Advisors, *Economic Report of the President, 1998*.

e Statistics Canada (1983), *Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries, 1980*.

f Department of Finance (1988), *The Canada-U.S. Free Trade Agreement: An Economic Assessment*, Table A2.1.

g Baldwin and Rafiquzzaman (1995), Appendix B.

h Department of Consumer and Corporate Affairs (1971), *Concentration in the Manufacturing Industries of Canada*, Tables IV-1 and A-5.

i Microeconomics Analysis Division, Statistics Canada

TABLE 2
Pass-through elasticities

Industry	Domestic prices: Direct	Domestic prices: Indirect	Domestic prices: Total[a]	Import prices: Direct	Import prices: Indirect	Import prices: Total[a]
Meat and meat products	0.000	0.788	0.788	0.060	0.623	0.683
Fish products	0.048	0.563	0.610	0.289	0.407	0.696
Fruit and vegetables	0.070	0.043	0.113	0.483	0.000	0.483
Vegetable oils (except corn oil)	0.192	0.005	0.197	0.456	0.001	0.457
Soft drinks	0.008	0.137	0.145	0.081	0.074	0.155
Distilleries	0.032	0.026	0.058	0.171	0.016	0.187
Plastic products	0.053	0.132	0.185	0.406	0.033	0.440
Leather tanneries	0.076	0.030	0.106	0.431	0.003	0.434
Footwear	0.020	0.100	0.120	0.043	0.012	0.055
Miscellaneous leather products	0.000	0.045	0.046	0.000	0.042	0.043
Man-made yarns and cloth	0.380	0.305	0.685	0.752	0.234	0.986
Hosiery	0.476	0.003	0.479	0.880	0.002	0.882
Veneer and plywood	0.000	0.458	0.458	0.169	0.403	0.571
Sash, door and other millwork	0.000	0.056	0.056	0.748	0.035	0.783
Other wood products	0.783	0.033	0.816	0.823	0.006	0.829
Household furniture	0.089	0.000	0.089	1.015	0.000	1.015
Steel pipes and tubes	0.487	0.097	0.585	0.873	0.072	0.945
Iron foundries	0.487	0.097	0.585	0.873	0.072	0.945
Non-ferrous metals smelting and refining	0.005	0.172	0.177	0.148	0.001	0.149
Aluminum rolling, casting and extruding	0.054	0.165	0.218	1.171	0.065	1.236
Copper rolling, casting and extruding	0.238	0.484	0.721	0.879	0.000	0.879
Power boilers and structural metals	0.128	0.172	0.300	0.504	0.109	0.613
Wire and wire products	0.130	0.082	0.212	0.610	0.051	0.661
Hardware, tools and cutlery	0.151	0.004	0.155	0.635	0.000	0.635
Heating equipment	0.058	0.032	0.090	0.619	0.018	0.637

TABLE 2 (Continued)
Pass-through elasticities

Industry	Domestic prices			Import prices		
	Direct	Indirect	Total[a]	Direct	Indirect	Total[a]
Agricultural implements	0.316	0.018	0.335	0.492	0.007	0.498
Commercial refrigeration and air conditioning equipment	0.205	0.027	0.232	0.632	0.007	0.640
Motor vehicles	0.200	0.087	0.286	0.413	0.035	0.448
Railroad rolling stock	0.316	0.018	0.335	0.799	0.024	0.823
Communication and other electronic equipment	0.144	0.007	0.150	0.780	0.002	0.782
Communication and energy wires and cables	0.698	0.163	0.862	0.911	0.039	0.950
Batteries	0.109	0.095	0.204	0.476	0.048	0.524
Hydraulic cement	0.334	0.004	0.338	0.992	0.002	0.994
Concrete products	0.051	0.028	0.079	0.437	0.014	0.451
Ready mix concrete	0.122	0.039	0.161	1.179	0.017	1.196
Refined petroleum and coal products	0.054	0.395	0.449	0.419	0.036	0.455
Toilet preparations	0.200	0.045	0.245	0.709	0.017	0.727

[a] Totals need not equal the sum of components due to rounding.

TABLE 3
Frequency distributions and summary statistics for pass-through elasticities

Range	Domestic elasticities			Import elasticities		
	Direct	Indirect	Total	Direct	Indirect	Total
0 - 0.099	17	24	6	4	32	2
0.1 - 0.199	7	7	10	3	1	3
0.2 - 0.299	4	0	6	1	1	0
0.3 - 0.399	4	2	4	0	0	0
0.4 - 0.499	3	2	3	9	2	8
0.5 - 0.599	0	1	2	1	0	2
0.6 - 0.699	1	0	1	4	1	7
0.7 - 0.799	1	1	2	5	0	3
0.8 - 0.899	0	0	2	5	0	4
0.9 - 0.999	0	0	0	2	0	5
1 and over	0	0	0	3	0	3
Mean	0.162	0.140	0.302	0.564	0.067	0.631
Standard Deviation	0.191	0.182	0.236	0.318	0.134	0.298
Minimum	0.000	0.000	0.046	0.000	0.000	0.043
Maximum	0.783	0.788	0.862	1.179	0.623	1.236

TABLE 4
Determinants of the exchange rate pass-through elasticities

Equation No.	Constant	H	TF	H*TF	NTB	MSR	XSR	PDIF	REGD	MASR	$\hat{\epsilon}_{mate}$	$\hat{\epsilon}_{mate}$* MASR	$\bar{R}^2$
Domestic elasticities													
Direct ($\hat{\epsilon}_{dD}$)													
4.1	0.135	0.360	0.009		-0.224*	-0.632*	0.524	0.173*	-0.141				0.15
	(1.08)	(1.05)	(1.41)		(2.55)	(1.90)	(1.64)	(1.91)	(1.56)				
4.2	0.171	0.004	0.002	0.088	-0.237*	-0.591*	0.503	0.155*	-0.146				0.17
	(1.36)	(0.01)	(0.21)	(1.51)	(2.76)	(1.85)	(1.64)	(1.83)	(1.61)				
Indirect ($\hat{\epsilon}_{dI}$)													
4.3	-0.094	-0.519*	-0.004		-0.239*	-0.160	0.168	-0.078*	0.057	0.250	0.501*		0.58
	(0.048)	(2.15)	(0.87)		(4.09)	(1.18)	(1.43)	(1.78)	(1.12)	(1.24)	(5.40)		
4.4	0.123	-1.019*	-0.013*	0.110*	-0.205*	-0.124	0.142	-0.093*	0.038			0.733*	0.66
	(1.17)	(3.19)	(2.21)	(3.36)	(4.80)	(1.04)	(1.03)	(2.66)	(0.85)			(6.61)	
Total ($\hat{\epsilon}_{de}$)													
4.5	-0.029	0.043	0.006		-0.367*	–0.781*	0.675*	0.128	-0.063	0.422*	0.261*		0.20
	(0.11)	(0.10)	(0.65)		(3.65)	(2.41)	(2.28)	(1.14)	(0.72)	(1.51)	(1.72)		
4.6	0.322	-0.780*	-0.011	0.187*	-0.430*	-0.732*	0.643*	0.072	-0.098			0.530*	0.35
	(2.31)	(1.85)	(0.98)	(2.76)	(6.13)	(2.49)	(2.54)	(0.71)	(1.25)			(3.24)	
Import elasticities													
Direct ($\hat{\epsilon}_{mD}$)													
4.7	0.729*	0.991*	-0.002		-0.450*	-0.772*		0.141	-0.215*				0.15
	(3.85)	(2.10)	(0.20)		(6.58)	(3.41)		(1.31)	(1.77)				
4.8	0.730*	0.980	-0.003	0.003	-0.451*	-0.771*		0.140	-0.215*				0.12
	(3.81)	(1.63)	(0.18)	(0.03)	(6.84)	(3.38)		(1.33)	(1.78)				

TABLE 4 Continued
Determinants of the exchange rate pass-through elasticities

Equation No.	Constant	H	TF	H*TF	NTB	MSR	XSR	PDIF	REGD	MASR	$\hat{\epsilon}_{mate}$	$\hat{\epsilon}_{mate}$* MASR	$\bar{R}^2$
Indirect ($\hat{\epsilon}_{mI}$)													
4.9	-0.043	-0.464*	-0.003		-0.100*	0.066		-0.059*	0.084*	0.081	0.302*		0.31
	(0.32)	(1.86)	(0.81)		(1.94)	(0.68)		(1.97)	(1.96)	(0.43)	(2.99)		
4.10	0.047	-0.873*	-0.010*	0.091*	-0.073*	0.092		-0.066*	0.075*			0.425*	0.41
	(0.76)	(2.50)	(2.14)	(2.73)	(2.69)	(0.97)		(2.71)	(1.87)			(2.99)	
Total ($\hat{\epsilon}_{me}$)													
4.11	1.242*	1.149*	-0.012		-0.582*	-0.814*		0.076	-0.141	-0.599	-0.036		0.14
	(4.39)	(2.10)	(0.96)		(4.33)	(4.06)		(0.70)	(1.12)	(1.65)	(0.16)		
4.12	0.855*	0.794	-0.013	0.063	-0.488*	-0.735*		0.104	-0.113			-0.165	0.11
	(4.76)	(1.02)	(0.87)	(0.64)	(6.82)	(3.45)		(1.03)	(0.89)			(0.76)	

* Indicates statistically significant at 10% , two-tailed test.

TABLE A1
Domestic Price Equations
Dependent variable: $\Delta \ln p_d$

Industry	constant	$\Delta \ln p_m$	$\Delta \ln p_{mat}$	$\Delta \ln w$	$\Delta \ln tfp$	y_{err}	$\bar{R}^2$	θ	D.W.
Meat and meat products	0.000 (0.21)	- 0.013 (0.39)	0.846 (26.4)	0.185 (2.11)	- 0.108 (0.57)	0.072 (0.59)	0.98	- 0.171 (0.83)	1.85
Fish products	- 0.001 (0.12)	0.165 (1.17)	0.705 (8.26)	0.215 (1.89)	-0.265 (2.43)	0.026 (0.10)	0.83	- 0.098 (0.54)	1.94
Fruit and vegetables	0.004 (0.85)	0.144 (2.51)	0.157 (1.61)	- 0.095 (1.03)	- 0.426 (4.13)	- 0.175 (1.21)	0.57	0.490 (3.00)	1.96
Vegetable oils (except corn oil)	- 0.005 (0.28)	0.422 (0.93)	0.023 (0.47)	- 0.474 (1.16)	0.531 (0.93)	1.376 (1.53)	0.29	0.023 (0.13)	2.00
Soft drinks	- 0.009 (1.20)	0.095 (0.53)	0.625 (5.16)	0.282 (1.34)	- 0.219 (1.20)	- 0.259 (0.82)	0.59	0.024 (0.13)	1.93
Distilleries	- 0.006 (0.66)	0.188 (1.61)	0.034 (0.31)	0.120 (0.51)	- 0.541 (3.52)	- 0.125 (0.30)	0.28	- 0.159 (0.82)	1.99
Plastic products	- 0.001 (0.26)	0.129 (0.97)	0.567 (7.50)	0.103 (0.56)	-0.410 (3.87)	0.256 (1.36)	0.79	- 0.392 (2.22)	1.86
Leather tanneries	0.008 (1.41)	0.176 (1.82)	0.427 (12.66)	-0.176 (1.44)	-0.264 (0.93)	1.025 (3.12)	0.92	0.063 (0.32)	1.99
Footwear	- 0.010 (2.51)	0.469 (3.79)	0.200 (3.95)	0.278 (4.10)	- 0.027 (0.22)	- 0.038 (0.23)	0.61	0.556 (3.41)	2.10
Miscellaneous leather products	- 0.010 (6.62)	0.468 (5.60)	0.050 (0.83)	0.202 (2.59)	- 0.058 (0.45)	- 0.232 (1.64)	0.32	- 0.623 (3.40)	1.85
Man-made yarns and cloth	- 0.005 (1.08)	0.505 (3.14)	0.376 (3.49)	- 0.027 (0.17)	- 0.039 (0.35)	0.058 (0.28)	0.53	- 0.397 (1.90)	1.89
Hosiery	- 0.017 (2.41)	0.541 (3.36)	0.044 (0.79)	0.225 (2.63)	- 0.041 (0.21)	- 0.357 (1.77)	0.54	0.549 (3.70)	1.74
Veneer and plywood	0.006 (1.30)	- 0.065 (0.48)	1.200 (5.66)	- 0.129 (0.80)	- 0.130 (0.68)	0.598 (1.44)	0.61	- 0.773 (3.80)	1.74
Sash, door and other millwork	0.005 (1.34)	- 0.016 (0.26)	0.312 (4.12)	0.037 (0.36)	- 0.193 (1.80)	0.854 (4.59)	0.67	0.011 (0.06)	1.95
Other wood products	- 0.015 (1.35)	0.952 (4.55)	0.197 (1.07)	0.751 (2.69)	- 0.433 (2.89)	1.250 (2.89)	0.67	- 0.058 (0.27)	1.91
Household furniture	0.001 (0.21)	0.088 (1.48)	-0.005 (0.11)	0.205 (4.45)	-0.459 (11.85)	0.618 (4.71)	0.61	1.000 (5.19)	2.05

TABLE A1 (Continued)

Industry	constant	$\Delta \ln p_m$	$\Delta \ln p_{mat}$	$\Delta \ln w$	$\Delta \ln tfp$	y_{err}	$\bar{R}^2$	θ	D.W.
Steel pipes and tubes	0.007 (0.91)	0.558 (3.17)	0.302 (1.66)	- 0.103 (0.55)	- 0.358 (2.30)	0.153 (0.29)	0.49	0.052 (0.22)	1.90
Iron foundries	-0.000 (0.01)	0.220 (1.59)	0.347 (3.74)	0.114 (1.46)	-0.099 (0.93)	-0.059 (0.23)	0.33	-0.127 (0.69)	1.95
Non-ferrous metals smelting and refining	0.002 (0.22)	0.033 (0.22)	0.752 (8.33)	- 0.019 (0.08)	- 0.184 (0.47)	1.149 (2.57)	0.82	- 0.369 (1.66)	1.84
Aluminum rolling, casting and extruding	0.012 (1.14)	0.046 (0.53)	0.240 (1.75)	-0.306 (0.82)	-1.006 (2.51)	1.519 (2.27)	0.20	-0.305 (1.68)	1.96
Copper rolling, casting and extruding	0.005 (0.58)	0.270 (2.00)	0.525 (4.82)	0.037 (0.11)	- 0.432 (1.53)	0.410 (0.65)	0.81	- 0.099 (0.47)	2.02
Power boilers and structural metals	- 0.000 (0.02)	0.255 (1.28)	0.554 (3.98)	0.025 (0.26)	0.210 (0.77)	- 0.105 (0.38)	0.53	- 0.138 (0.69)	1.94
Wire and wire products	- 0.003 (0.88)	0.214 (1.54)	0.399 (4.65)	0.224 (2.18)	- 0.056 (0.65)	0.317 (1.69)	0.59	0.189 (1.06)	2.03
Hardware, tools and cutlery	0.001 (0.16)	0.237 (2.13)	0.014 (0.24)	0.243 (5.88)	- 0.025 (0.25)	- 0.053 (0.47)	0.32	1.000 (9.72)	2.28
Heating equipment	- 0.005 (1.21)	0.094 (0.87)	0.112 (2.47)	- 0.095 (1.34)	0.065 (0.84)	- 0.296 (1.72)	0.32	0.527 (3.27)	1.98
Agricultural implements	-0.002 (0.53)	0.643 (2.45)	0.159 (1.04)	-0.198 (1.53)	0.155 (1.60)	-0.088 (0.36)	0.28	-0.029 (0.15)	1.98
Commercial refrigeration and air conditioning equipment	- 0.006 (2.09)	0.324 (2.02)	0.081 (0.85)	0.142 (1.36)	- 0.098 (1.09)	0.484 (2.06)	0.12	- 0.367 (2.21)	1.80
Motor vehicles	- 0.007 (0.87)	0.482 (2.32)	0.085 (2.64)	0.138 (1.57)	0.024 (0.56)	0.115 (0.58)	0.66	1.000 (7.24)	2.04
Railroad rolling stock	0.010 (1.27)	-0.106 (0.41)	0.527 (2.83)	-0.239 (1.13)	-0.127 (1.06)	-0.345 (0.86)	0.22	0.044 (0.23)	1.92
Communication & other electronic equipment	- 0.009 (1.36)	0.184 (1.10)	0.116 (2.14)	0.181 (1.54)	- 0.302 (3.51)	0.637 (2.79)	0.47	- 0.180 (0.92)	2.04

TABLE A1 (Continued)

Industry	constant	Δ ln p_m	Δ ln p_{mat}	Δ ln w	Δ ln tfp	y_{err}	$\bar{R}^2$	θ	D.W.
Communication and energy wires and cables	0.014 (1.44)	0.767 (5.54)	0.276 (3.29)	- 0.165 (0.96)	- 0.265 (1.24)	0.294 (0.56)	0.72	0.464 (2.81)	2.01
Batteries	- 0.007 (0.94)	0.229 (0.93)	0.104 (1.90)	- 0.007 (0.04)	0.154 (0.90)	- 0.012 (0.04)	0.17	0.386 (2.08)	1.85
Hydraulic cement	- 0.001 (0.16)	0.337 (2.54)	0.009 (0.07)	0.090 (0.83)	- 0.021 (0.19)	- 0.685 (1.49)	0.33	0.288 (1.68)	2.04
Concrete products	- 0.001 (0.14)	0.116 (0.52)	0.463 (3.18)	0.091 (0.66)	- 0.095 (0.76)	0.072 (0.27)	0.19	- 0.035 (0.18)	1.93
Ready mix concrete	-0.002 (0.42)	0.103 (1.73)	0.356 (1.98)	0.151 (1.03)	-0.115 (0.75)	0.016 (0.07)	0.21	0.273 (1.42)	2.02
Refined petroleum and coal products	- 0.001 (1.63)	0.128 (0.87)	0.730 (9.76)	0.393 (1.71)	0.192 (0.26)	- 0.762 (1.32)	0.82	- 0.354 (1.98)	1.98
Toilet preparations	- 0.004 (0.88)	0.282 (2.05)	0.104 (0.92)	0.072 (0.52)	- 0.202 (2.13)	0.101 (0.46)	0.32	0.229 (1.28)	2.06

NOTES: Absolute t-values in brackets. p_m is the predicted value of the import price. θ is the estimated value of the MA(1) error parameter. D.W. is the Durbin-Watson d statistic.

TABLE A2
Import Price Equations
Dependent variable: $\Delta \ln p_m$

Industry	constant	$\Delta \ln p_d$	$\Delta \ln e$	$\Delta \ln c_{US}$	y_{err}	$\bar{R}^2$	θ	D.W.
Meat and meat products	0.001 (0.04)	0.791 (2.95)	0.060 (0.18)	0.474 (2.93)	1.701 (2.34)	0.55	0.335 (1.86)	1.90
Fish products	- 0.000 (0.03)	0.723 (2.99)	0.254 (1.30)	0.258 (1.64)	0.678 (1.55)	0.43	0.173 (0.89)	2.06
Fruit and vegetables	- 0.003 (0.63)	- 0.270 (0.52)	0.483 (3.46)	1.351 (7.14)	- 0.793 (2.45)	0.62	- 0.392 (2.12)	1.68
Vegetable oils (except corn oil)	0.000 (0.02)	0.285 (1.48)	0.401 (1.66)	0.529 (5.26)	0.838 (1.27)	0.61	- 0.503 (3.03)	1.82
Soft drinks	0.002 (0.30)	0.541 (2.50)	0.077 (0.42)	0.463 (2.77)	- 0.181 (0.42)	0.45	- 0.367 (2.00)	1.93
Distilleries	- 0.004 (0.35)	0.616 (1.43)	0.151 (0.59)	0.036 (0.14)	2.522 (3.07)	0.25	- 0.471 (2.89)	1.82
Plastic products	- 0.011 (1.35)	0.253 (1.84)	0.393 (2.79)	0.192 (1.49)	0.473 (1.78)	0.43	0.656 (3.76)	1.99
Leather tanneries	-0.004 (0.61)	0.109 (0.70)	0.423 (2.09)	0.711 (6.81)	0.761 (1.43)	0.77	-0.261 (1.44)	2.00
Footwear	0.007 (0.87)	0.116 (0.37)	0.041 (0.25)	0.001 (0.00)	0.772 (2.28)	0.16	0.304 (1.74)	1.90
Miscellaneous leather products	0.000 (0.00)	0.932 (3.16)	0.000 (0.00)	- 0.010 (0.18)	0.133 (0.83)	0.46	0.995 (5.65)	1.87
Man-made yarns and cloth	0.005 (0.55)	0.766 (2.43)	0.461 (3.38)	0.325 (2.19)	- 0.034 (0.10)	0.46	- 0.132 (0.67)	1.90
Hosiery	0.003 (0.33)	0.792 (3.21)	0.503 (4.80)	0.260 (2.76)	- 0.003 (0.01)	0.70	0.037 (0.21)	1.98
Veneer and plywood	0.009 (4.10)	0.879 (2.22)	0.169 (0.57)	0.766 (7.23)	1.050 (1.92)	0.67	- 1.000 (5.72)	1.71
Sash, door and other millwork	0.010 (1.22)	0.629 (0.91)	0.748 (3.39)	- 0.137 (0.38)	0.647 (1.01)	0.20	- 0.294 (1.55)	1.82
Other wood products	0.009 (0.91)	0.184 (1.90)	0.679 (9.36)	0.297 (2.31)	0.660 (2.49)	0.74	1.000 (6.88)	2.32
Household furniture	-0.017 (1.25)	0.169 (0.12)	1.000 (3.22)	1.423 (2.02)	0.357 (0.43)	0.28	-0.079 (0.37)	1.94

TABLE A2 (Continued)

Industry	constant	Δ ln p_d	Δ ln e	Δ ln c_{US}	y_{err}	$\bar{R}^2$	θ	D.W.
Steel pipes and tubes	- 0.007 (0.79)	0.735 (3.98)	0.515 (3.16)	0.287 (1.78)	- 0.197 (0.45)	0.55	0.415 (2.07)	1.93
Iron foundries	-0.012 (0.91)	0.354 (0.38)	0.351 (1.15)	0.613 (1.67)	0.108 (0.17)	0.08	0.124 (0.62)	2.00
Non-ferrous metals smelting and refining	- 0.000 (0.02)	0.004 (0.03)	0.148 (0.48)	0.306 (3.31)	- 0.085 (0.17)	0.46	1.000 (6.03)	2.25
Aluminum rolling, casting and extruding	0.011 (1.72)	0.396 (0.41)	1.150 (2.26)	1.495 (3.41)	0.800 (0.55)	0.32	-1.000 (9.66)	1.46
Copper rolling, casting and extruding	0.003 (2.41)	- 0.005 (0.04)	0.879 (4.27)	1.028 (7.36)	1.100 (2.07)	0.72	- 1.000 (7.39)	1.51
Power boilers and structural metals	- 0.000 (0.07)	0.637 (1.73)	0.422 (2.68)	0.322 (1.35)	0.371 (1.14)	0.33	- 0.125 (0.45)	1.94
Wire and wire products	0.002 (0.52)	0.620 (1.71)	0.530 (5.81)	0.373 (2.85)	0.107 (0.47)	0.56	- 0.280 (1.52)	1.99
Hardware, tools and cutlery	- 0.001 (0.08)	- 0.323 (0.53)	0.635 (3.32)	0.410 (1.45)	0.268 (0.64)	0.24	0.119 (0.61)	2.00
Heating equipment	- 0.005 (3.16)	0.560 (2.39)	0.586 (6.40)	- 0.102 (1.01)	0.303 (1.44)	0.62	- 1.000 (6.07)	1.37
Agricultural implements	-0.005 (0.99)	0.373 (1.29)	0.374 (4.12)	0.149 (1.52)	-0.232 (1.09)	0.58	0.405 (1.92)	1.93
Commercial refrigeration and air conditioning equipment	- 0.001 (0.24)	0.273 (0.71)	0.576 (4.21)	0.082 (0.61)	0.460 (1.36)	0.32	- 0.313 (1.60)	1.90
Motor vehicles	- 0.004 (0.65)	0.405 (1.83)	0.332 (2.83)	0.141 (1.24)	0.293 (1.50)	0.64	0.401 (2.25)	1.83
Railroad rolling stock	-0.004 (0.57)	0.096 (0.54)	0.799 (4.98)	0.261 (2.57)	0.164 (0.50)	0.54	0.044 (0.23)	1.97
Communication and other electronic equipment	- 0.022 (1.08)	0.291 (0.39)	0.739 (3.38)	0.097 (0.87)	0.734 (1.53)	0.24	0.016 (0.09)	2.00
Communication and energy wires and cables	- 0.006 (0.63)	0.241 (0.89)	0.743 (2.48)	0.629 (3.01)	0.873 (1.57)	0.46	- 0.057 (0.32)	1.99
Batteries	0.003 (0.46)	0.503 (1.04)	0.421 (3.42)	0.042 (0.24)	- 0.110 (0.40)	0.31	0.087 (0.46)	1.98
Hydraulic cement	- 0.000 (0.57)	0.641 (2.36)	0.778 (6.02)	0.195 (2.11)	1.155 (5.02)	0.75	- 1.000 (5.83)	2.17

TABLE A2 (Continued)

Industry	constant	$\Delta \ln p_d$	$\Delta \ln e$	$\Delta \ln c_{US}$	y_{err}	$\bar{R}^2$	θ	D.W.
Concrete products	0.005 (1.29)	0.511 (1.71)	0.411 (3.84)	- 0.010 (0.07)	0.268 (1.07)	0.27	- 0.312 (1.68)	2.02
Ready mix concrete	0.009 (0.57)	0.424 (0.31)	1.128 (2.92)	0.154 (0.29)	-0.706 (0.85)	0.17	-0.065 (0.35)	1.97
Refined petroleum and coal products	0.017 (1.74)	0.092 (0.58)	0.414 (1.35)	0.830 (7.38)	1.056 (1.38)	0.67	- 0.357 (2.10)	1.95
Toilet preparations	- 0.002 (0.41)	0.380 (1.03)	0.633 (6.83)	0.075 (0.79)	- 0.194 (0.93)	0.64	- 0.209 (1.17)	1.93

NOTES: Absolute t - values in brackets. p_d is the predicted value of the domestic price. θ is the estimated value of the MA(1) error parameter. D.W. is the Durbin-Watson d statistic.

TABLE A3
Materials Price Equations
Dependent variable: $\Delta \ln p_{mat}$

Industry	constant	$\Delta \ln e$	$\Delta \ln p_{matu}$	y_{err}	$\bar{R}^2$	θ	D.W.
Meat and meat products	- 0.003 (2.46)	0.931 (8.72)	0.909 (12.7)	0.119 (0.44)	0.86	- 1.000 (6.90)	1.57
Fish products	0.008 (5.26)	0.704 (4.83)	0.502 (5.40)	1.844 (4.34)	0.43	- 1.000 (9.17)	1.26
Fruit and vegetables	0.001 (0.29)	0.276 (3.60)	0.374 (4.38)	0.258 (1.39)	0.54	- 0.082 (0.43)	1.94
Vegetable oils (except corn oil)	- 0.006 (0.79)	0.190 (0.26)	0.655 (2.14)	1.274 (0.62)	0.51	- 1.000 (6.39)	2.12
Soft drinks	- 0.005 (0.78)	0.208 (1.41)	0.665 (6.93)	- 0.154 (0.43)	0.65	0.059 (0.29)	1.97
Distilleries	- 0.001 (0.09)	0.663 (2.75)	- 0.267 (1.59)	- 0.385 (0.67)	0.17	0.046 (0.25)	1.99
Plastic products	0.002 (0.32)	0.226 (1.52)	0.694 (6.10)	0.186 (0.56)	0.53	- 0.095 (0.53)	1.96
Leather tanneries	-0.013 (6.26)	0.070 (0.38)	1.452 (12.19)	0.239 (0.47)	0.90	-1.000 (7.45)	1.44
Footwear	0.001 (0.39)	0.473 (4.66)	1.082 (5.79)	0.600 (1.86)	0.62	- 0.752 (6.05)	1.87
Miscellaneous leather products	- 0.003 (0.53)	0.512 (3.42)	- 0.080 (0.43)	0.447 (1.22)	0.24	- 0.457 (2.63)	1.85
Man-made yarns and cloth	- 0.017 (2.06)	0.497 (3.25)	0.208 (2.17)	0.189 (0.63)	0.37	0.516 (3.05)	2.10
Hosiery	- 0.014 (1.30)	0.036 (0.17)	0.262 (1.22)	- 0.850 (1.65)	0.03	- 0.175 (0.94)	1.91
Veneer and plywood	0.002 (0.95)	0.382 (4.24)	0.412 (7.02)	0.467 (1.84)	0.59	- 0.526 (3.42)	1.78
Sash, door and other millwork	0.000 (0.54)	0.179 (1.92)	0.738 (6.06)	0.536 (1.97)	0.57	- 1.000 (8.11)	1.50
Other wood products	- 0.004 (0.50)	0.139 (0.69)	0.326 (2.02)	0.231 (0.45)	0.13	0.014 (0.07)	1.99
Household furniture	-0.000 (0.10)	0.379 (2.96)	0.311 (1.07)	0.450 (1.38)	0.15	-0.270 (1.44)	1.89

TABLE A3 (Continued)							
Industry	constant	Δ ln e	Δ ln p_{matu}	y_{err}	$\bar{R}^2$	θ	D.W.
Steel pipes and tubes	- 0.005 (2.10)	0.190 (1.71)	0.341 (3.58)	1.470 (4.67)	0.340	- 0.667 (4.17)	1.66
Iron foundries	-0.005 (2.74)	0.199 (1.77)	0.415 (6.02)	0.565 (1.95)	0.45	-0.784 (5.98)	1.82
Non-ferrous metals smelting and refining	0.001 (0.11)	0.229 (0.88)	0.928 (6.46)	0.937 (1.52)	0.64	- 0.242 (1.34)	1.86
Aluminum rolling, casting and extruding	-0.006 (2.61)	0.675 (2.20)	0.942 (4.24)	-0.151 (0.20)	0.41	-1.000 (9.54)	1.62
Copper rolling, casting and extruding	- 0.004 (1.17)	0.921 (3.72)	1.044 (6.31)	1.908 (2.59)	0.70	- 0.749 (5.60)	1.64
Power boilers and structural metals	- 0.003 (0.70)	0.260 (2.46)	0.548 (4.42)	0.354 (1.37)	0.35	- 0.338 (1.75)	1.82
Wire and wire products	- 0.007 (13.2)	0.178 (2.72)	0.631 (13.0)	- 0.027 (0.15)	0.59	- 1.000 (7.99)	1.83
Hardware, tools and cutlery	- 0.002 (1.12)	0.288 (3.18)	0.303 (2.73)	0.436 (1.72)	0.15	- 0.767 (5.80)	1.51
Heating equipment	- 0.004 (1.86)	0.270 (1.85)	0.110 (0.54)	0.005 (0.01)	0.14	-1.000 (8.40)	1.17
Agricultural implements	-0.008 (1.93)	0.089 (0.87)	0.365 (3.30)	-0.327 (1.33)	0.28	-0.145 (0.75)	2.03
Commercial refrigeration and air conditioning equipment	- 0.001 (0.21)	0.305 (2.12)	0.094 (0.74)	0.317 (0.90)	0.11	-0.166 (0.90)	1.97
Motor vehicles	0.010 (3.09)	0.830 (5.13)	0.693 (2.51)	0.179 (0.49)	0.65	- 1.000 (7.72)	2.21
Railroad rolling stock	-0.004 (0.75)	0.474 (3.57)	0.128 (1.61)	0.128 (0.42)	0.25	-0.122 (0.65)	1.91
Communication and other electronic equipment	- 0.027 (5.06)	0.056 (0.26)	- 0.120 (1.17)	1.300 (2.35)	0.43	- 1.000 (8.29)	2.15
Communication and energy wires and cables	- 0.007 (1.82)	0.482 (2.53)	0.583 (4.41)	1.255 (2.65)	0.54	- 0.637 (4.64)	1.96
Batteries	0.011 (4.18)	0.803 (3.71)	0.914 (5.95)	0.747 (1.64)	0.45	- 1.000 (6.13)	2.26

TABLE A3 (Continued)

Industry	constant	Δ ln e	Δ ln p_{matu}	y_{err}	$\bar{R}^2$	θ	D.W.
Hydraulic cement	- 0.000	0.330	0.225	- 0.191	0.16	- 0.054	1.93
	(0.06)	(2.30)	(2.06)	(0.60)		(0.30)	
Concrete products	0.000	0.057	0.190	- 0.239	0.03	0.023	2.01
	(0.05)	(0.52)	(1.81)	(0.93)		(0.13)	
Ready mix concrete	-0.001	0.105	0.244	-0.379	0.15	0.102	2.00
	(0.28)	(1.10)	(1.81)	(1.77)		(0.58)	
Refined petroleum and	0.006	0.535	0.891	- 0.347	0.74	0.048	1.99
coal products	(0.41)	(1.60)	(9.08)	(0.48)		(0.25)	
Toilet preparations	- 0.000	0.386	0.218	0.340	0.51	- 1.000	1.92
	(0.19)	(5.34)	(2.49)	(1.62)		(7.29)	

NOTES: Absolute t-values in brackets. θ is the estimated value of the MA(1) error parameter. D.W. is the Durbin-Watson d statistic.

Footnotes:

1. See, for example, the survey article by Goldberg and Knetter (1997).

2. The Input-Output Division of Statistics Canada distinguishes between 94 L-level manufacturing industries. Twenty of these industries were dropped from our study because of the difficulties associated with matching Canadian and U.S. data. Another industry (asphalt roofing) was dropped because the import price series appeared to be unreliable.

3. Given the small size of the Canadian market relative to that of the U.S., it seems reasonable to assume that p_{matu} is exogenous.