MANUFACTURING IMPORT FUNCTIONS FOR CANADA, JAPAN AND THE UNITED STATES†

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This paper provides fresh estimates of manufacturing import demand functions based on recent quarterly and annual data for Canada, Japan and the United States.[1] Such estimates are important because the time series data are believed to have undergone important structural shifts due to major changes at the national and international levels (energy crises, floating exchange rates, etc.). Moreover, unlike most of the available evidence, the estimates in the present study provide a somewhat detailed analysis of the short-run behavior of manufacturing imports.

The quarterly estimates are based on the period 1969–78 for Canada, and 1968–78 for Japan and the United States. The annual estimates cover the period 1960–77 for Japan and the United States, and 1962–77 for Canada. (Details of data are given in Appendix A). Section I briefly reviews the role of manufacturing trade in total trade; underlying this review is the importance of manufacturing imports in policy considerations. Section II outlines the estimating equations, while Section III discusses the main results. In Section IV, we compare the estimates in this study with estimates from some of the earlier studies.

I. *Manufacturing Goods and Trade Balance Movements*

As in other industrial countries, manufacturing trade forms the bulk of international merchandise trade for Canada, Japan and the United States. During the period 1970–77, manufacturing goods have been, on average, considerably more than one-half of total exports and imports in Canada and the United States (see Table 1). In Japan, manufacturing goods have accounted for almost 95 percent of total exports but only about 25 percent of total imports over the same period.

Since the early 1970s, the share of manufacturing exports in total exports has remained

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† The views expressed in this paper are my own and do not necessarily reflect those of the Federal Reserve Bank of New York. I am grateful to D. Dungca and N. Gustafson for computational assistance.

[1] Akhtar (1979) provides similar estimates for France, Germany and the United Kingdom. At the outset, it should be noted that this paper does not deal with the issue of inter-temporal stability of long-run elasticities except in the sense that it presents a comparison of such estimates with previous estimates. Moreover, the paper does not include an explicit analysis of the implications of results; that subject has been extensively pursued in other recent studies, some of which are mentioned below. Instead, the focus is on estimates of short- and long-term elasticities underlying the recent data. On the subject of stability, two recent studies for the United States, Hooper (1978), and Stern, Baum and Greene (1979)—both at the aggregative level of imports—are worth mentioning. For the major industrial countries, Akhtar (1980) provides a brief analysis of the same subject.

TABLE 1. MANUFACTURING AND TOTAL EXPORTS, AND MANUFACTURING AND TOTAL IMPORTS, 1960 AND 1970–77

	Manufacturing Exports as % of Total Exports (nominal)			Manufacturing Exports as % of GNP (nominal)			Total Exports as % of GNP (nominal)		
	U.S.	Japan	Canada	U.S.	Japan	Canada	U.S.	Japan	Canada
1960	61.7	88.8	42.8	2.5	8.4	6.3	4.1	9.4	14.7
1670	67.8	93.7	58.0	3.0	9.2	11.9	4.4	9.8	20.5
1971	68.9	94.2	56.6	2.9	10.0	11.1	4.2	10.6	19.6
1972	67.9	93.3	55.4	2.9	8.9	11.0	4.3	9.5	19.9
1973	62.7	94.1	51.8	3.4	8.3	11.1	5.5	8.9	21.4
1974	64.5	94.4	46.4	4.5	11.4	10.6	7.0	12.0	22.9
1975	66.0	95.3	49.0	4.6	10.6	10.3	7.0	11.1	21.0
1976	67.1	96.1	49.9	4.5	11.5	10.4	6.8	11.6	20.9
1977	66.2	96.3	53.2	4.3	11.2	11.7	6.4	10.0	22.0
Precent Change									
1977/1960	7.3	8.4	24.3	72.0	33.3	85.7	56.1	6.4	49.7
1977/1970	− 2.4	2.8	− 8.3	43.3	21.7	− 1.7	45.5	2.0	7.3
	Manufacturing Imports as % of Total Imports (nominal)			Manufacturing Imports as % of GNP (nominal)			Tatal Imports as % of GNP (nominal)		
1960	45.1	23.7	68.0	1.3	2.1	10.1	3.0	8.7	14.9
1970	64.8	31.6	77.6	2.6	2.5	13.1	4.1	8.0	16.9
1971	66.7	29.3	78.1	2.9	2.2	13.3	4.3	7.3	17.1
1972	68.0	29.8	79.1	3.2	2.0	14.4	4.8	6.6	18.3
1973	64.8	30.8	77.4	3.4	2.4	15.1	5.3	7.9	19.4
*1974	55.1	23.6	73.6	3.9	2.8	16.3	7.1	11.8	22.1
1975	53.2	20.0	72.0	3.3	2.0	15.6	6.3	10.2	21.7
1976	53.7	20.5	73.4	3.8	2.1	14.8	7.1	10.3	20.1
1977	51.9	20.2	74.4	4.1	1.9	15.4	7.8	9.3	20.7
Percent Change									
1977/1960	15.1	−14.8	9.4	315.4	− 9.5	52.5	260.0	6.9	38.9
1977/1970	−19.9	−36.1	− 4.1	57.7	−24.0	17.6	190.2	16.3	22.5

* Oil crisis; ratios of manufacturing imports to total imports fall because of sharp increases in the value of raw material imports.

quite stable in all three countries under consideration. By contrast, the share of manufacturing imports in total imports has exhibited a great deal of instability over this period. In terms of ratios to GNP, both manufacturing exports and imports have shown considerable volatility. But, on the whole, fluctuations have been larger on the import side than on the export side. More importantly, there are notable differences in the magnitude and direction of changes in these ratios among the three countries. In Canada and the United States, the ratio of manufacturing imports to GNP rose substantially faster than the ratio of manufacturing exports to GNP over the period 1970–77. In the case of Japan, however, the ratio of manufacturing exports to GNP has risen whereas the ratio of manufacturing imports to GNP has fallen substantially over the same period. This has been, of course, reflected in the respective trade account movements.

It is quite apparent from the foregoing comments that manufacturing tade has been the most important contributor to changes in trade balances in Canada, Japan and the United States. Because of the relatively larger instability of manufacturing goods on the import side, manufacturing imports seem to have played a larger role in trade balance movements than manufacturing exports. Thus, the behavior of manufacturing imports is one of the most important elements in understanding the trade balance problems.

II. *Estimation Framework*

The general import demand function utilized in this study is:

$$M=F(Y,\ (Pm/Pw),\ (IP/IPx));\ \text{with}$$
$$Fy>0,\ F_{(Pm/Pw)}<0\ \text{and}\ F_{(IP/IPx)}\gtrless 0 \qquad (1)$$

where M=manufacturing import volume, Y=real GNP, Pm=manufacturing import price (unit value), Pw=wholesale price, IP=industrial production, and IPx=trend industrial production. The first two terms on the right-hand side are the usual activity and relative price variables. The third term captures the effects of cyclical influences. Its relationship to imports is ambiguous. It may behave like a price variable if producers ration the available supplies through waiting time, credit terms and other non-price methods in response to higher demand pressures. In other words, capacity utilization is a proxy for queue-length which is an indirect element of prices. On the other hand, it may be positively related to imports if higher demand pressures and capacity utilization encourage substitution of imports for domestic goods either through price competition or because domestic production is not able to meet higher demand.[2]

Equation (1) was estimated in double logarithmic form for manufacturing imports for Canada, Japan and the United States. Quarterly data included seasonal dummies for all three countries and dock strike dummies for the United States. In order to capture the lags in effect of income and price changes, we experimented with several lag configurations. First, we tested the usual partial adjustment specification which incorporates the one-period lagged value of the dependent variable as an independent variable. In most cases, this specification did not provide satisfactory results.

Second, a dynamic flow adjustment model was estimated for all three countries. The estimating equation based on this model is:[3]

$$lnM_{it}=a_0+a_1(ln\,Y_{it}+ln\,Y_{it-1})+a_2(ln(Pm/Pw)_{it}+ln(Pm/Pw)_{it-1})+a_3(ln(IP/IPx)_{it}$$
$$+ln(IP/IPx)_{it-1})+a_4 lnM_{it-1}+a_5 D1+a_6 D2+a_7 D3+a_8 DSK \qquad (2)$$

where i refers to country; t represents current time period; $D1$, $D2$ and $D3$ are quarterly seasonal dummies; DSK is a dock strike dummy for the United States; and all other notations are same as in the case of equation (1). This specification provides statistically quite satisfactory results for all three countries.

Finally, we tried a second degree Almon polynomial for 3–12 quarter lags with and

[2] For further analysis of cyclical influences and non-price variables, see, among others, Leamer and Stern (1970), Gregory (1971), Magee (1975), Khan and Ross (1975) and Akhtar (1979a). There is a vast amount of literature on the specification problems underlying equation (1), which is the standard general formulation. The issues involved are very basic but there is no satisfactory resolution of most of these issues at the empirical level. Needless to say, the present exercise does not deal with these issues.

[3] See Houthakker and Taylor (1970) and Houthakker and Magee (1969) for derivation of this equation and the implied long-run elasticities.

without constraining the far end-point to zero. These results are mixed and, in general, somewhat sensitive to the number of lags and the nature of the far end-point constraint.

III. *Results*

Table 2 presents quarterly results without any consideration of adjustment lags. Estimates of equation (2)—the flow adjustment specification—for quarterly data are reported in Table 3. The Almon polynomial model does not yield statistically reliable results for Canada since the adjustment of import volume with respect to income and prices appears to be complete within two or three quarters (certainly within a year). Even for Japan the lags in income and price effects seem fairly short. Thus, while the polynomial estimate for Japan with six quarter lags—reported in Table 4—is statistically satisfactory, the parameter estimates and overall properties of this specification are virtually identical to those of the flow adjustment specification. The adjustment lags especially with respect to prices appear to be rather long for the United States and the Almon estimates contain considerable useful information on the lag structure. Even so, in most cases, the *overall properties* of these estimates are roughly similar to those of the flow adjustment specification. Three Almon estimates for the United States are presented in Table 4. Finally, Table 5 reports estimates based on annual data for all three countries. The following discussion is an overview of our main results.

TABLE 2. MANUFACTURING IMPORT FUNCTIONS WITH FULL ADJUSTMENT WITHIN A SINGLE PERIOD, QUARTERLY OBSERVATIONS

	Adjusted R-Square	Standard Error	Durbin-Watson	Auto-Regressive Coefficient
Canada (Estimation period: Q1, 1969—Q1, 1978)				
$lnM_t=-1.39+1.18^*lnY_t-0.16ln(Pm/Pw)_t$	0.85	0.044	1.99	0.26*
(1.60) (6.81) (0.47)				(1.73)
$+1.11^*ln(IP/IPx)_t+0.11^*D1+0.01D2+0.01^*D3$				
(3.29) (5.83) (0.25) (3.63)				
Japan (Estimation period: Q1, 1968—Q1, 1978)				
$lnM_t=-10.38^*+1.27^*lnY_t-1.38^*ln(Pm/Pw)_t$	0.81	0.059	2.02	0.63*
(2.54) (3.69) (4 54)				(5.08)
$+0.76^*ln(IP/IPx)_t+0.02D1+0.01D2+0.01D3$				
(4.00) (1.05) (0.47) (0.57)				
United States (Estimation period: Q1, 1968—Q2, 1978)				
$lnM_t=-10.74^*+2.11^*lnY_t-0.22ln(Pm/Pw)_t$	0.58	0.065	2.04	0.57*
(3.73) (5.41) (0.44)				(4.34)
$+0.14ln(IP/IPx)_t+0.001DSK+0.06^*D1+0.00D2$				
(0.33) (0.03) (2.70) (0.11)				
$+0.03D3$				
(1.35)				

Notes: M=manufacturing import volume; Y=real GNP; Pm=import prices (unit value); Pw=wholesale prices; IP=industrial production; IPx=industrial production trend index; $D1$, $D2$, $D3$=seasonal dummies; subscript t refers to the current period; t-distribution values are given in parentheses below coefficients, those marked with an asterisk are significant at the 95 percent confidence level (one-tail test).

As can be seen in Table 2, the estimates based on complete adjustment within a single period (i.e., disregarding lags in effects) are not satisfactory. R-squares are quite low, standard errors are relatively large, and the price variables are not significant for Canada and the United States. Moreover, the OLS estimates contained a high level of serial correlation so that the Cochrane-Orcutt procedure had to be utilized to obtain the estimates in Table 2.

Taking account of lags in income and price effects with respect to imports produces major improvements in our estimates for all three countries. For Canada and Japan, Table 3 estimates based on the flow adjustment specification in equation (2) are virtually identical to those in Table 5 based on annual data. For Japan, the Almon polynomial estimate in Table 4 is also similar to the other two estimates. All of these results indicate that the long-run income elasticity of manufacturing imports is around unity for Canada and 1.3 to 1.4 for Japan, while the long-run price elasticity is somewhat below unity for Canada and about −1.5 for Japan. The cyclical variables yield positive signs and are significant for both countries.

TABLE 3. MANUFACTURING IMPORT FUNCTIONS: ESTIMATES OF EQUATION (2) WITH QUARTERLY OBSERVATIONS

	Adjusted R-Square	Standard Error	Serial Correlation Coefficient	Long-Run Elasticities	
				Income	Price
Canada (Estimation period: Q1, 1969—Q1, 1978)					
$lnM_t = -0.18 + 0.43^*(lnY_t + lnY_{t-1})$	0.90	0.044	0.05	0.93	−0.72
(0.20) (3.11)					
$-0.33^*(ln(Pm/Pw)_t + ln(Pm/Pw)_{t-1})$					
(2.15)					
$+0.34^*(ln(IP/IPx)_t + ln(IP/IPx)_{t-1})$					
(1.78)					
$+0.08 lnM_{t-1} + 0.11^* D1 - 0.00 D2 + 0.07^* D3$					
(0.53) (4.13) (0.17) (2.85)					
Japan (Estimation period: Q1, 1968—Q1, 1978)					
$lnM_t = -7.24^* + 0.44^*(lnY_t + lnY_{t-1})$	0.97	0.055	0.18	1.28	−1.51
(4.25) (5.28)					
$-0.52^*(ln(Pm/Pw)_t + ln(Pm/Pw)_{t-1})$					
(4.40)					
$+0.32^*(ln(IP/IPx)_t + ln(IP/IPx)_{t-1})$					
(5.94)					
$+0.31^* lnM_{t-1} + 0.04 D1 + 0.03 D2 + 0.05^* D3$					
(3.02) (1.57) (1.12) (1.78)					
United States (Estimation period: Q1, 1968—Q2, 1978)					
$lnM_t = -8.17^* + 0.71^*(lnY_t + lnY_{t-1})$	0.87	0.062	0.03	2.96	−1.38
(3.72) (3.96)					
$-0.33^*(ln(Pm/Pw)_t + ln(Pm/Pw)_{t-1})$					
(1.79)					
$-0.08(ln(IP/IPx)_t + ln(IP/IPx)_{t-1}) + 0.52^* lnM_{t-1}$					
(0.61) (3.83)					
$+0.003 DSK + 0.08^* D1 + 0.002 D2 + 0.04 D3$					
(0.12) (2.79) (0.07) (1.36)					

Notes: see Table 2.

TABLE 4. ALMON POLYNOMIAL DISTRIBUTED LAG MANUFACTURING IMPORT FUNCTIONS FOR JAPAN AND THE UNITED STATES

Japan (Estimation Period: Q1, 1968—Q1, 1978)

Second degree polynomial with the far end point constrained to zero 6 quarters back for the three main variables:

$$lnM_t = -9.93 + 1.24 lnY - 1.53 ln(Pm/Pw) + 0.93 ln(IP/IPx) + 0.03D1 + 0.02D2 + 0.03D3$$
(3.56) (5.27) (5.36) (3.56) (0.96) (0.79) (1.30)

Adjusted R-Square=0.97; Standard Error=0.054; Durbin-Watson=1.44

Distributed Lag on Income

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	Sum
−0.34	0.07	0.33*	0.45*	0.44*	0.29	1.24*
(0.64)	(0.38)	(3.52)	(2.01)	(1.71	(1.58)	(5.27)

Distributed Lag on Prices

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	Sum
−0.48*	−0.38*	−0.28*	−0.20*	−0.12*	−0.57*	−1.53*
(2.51)	(4.31)	(4.70)	(2.36)	(1.38)	(0.92)	(5.36)

United States (Estimation Period: Q1, 1967—Q2. 1978)

1. Second degree polynomial with the far end point constrained to zero 8 quarters back for the income and cyclical variables, and 12 quarters back for the price variable:

$$lnM_t = -17.97^* + 3.08^* lnY - 2.99^* ln(Pm/Pw) - 2.11^* ln(IP/IPx)$$
(7.65) (9.79) (6.50) (5.20)

$$+0.01DSK + 0.04^* D1 - 0.02D2 - 0.00D3$$
(0.39) (2.03) (1.24) (0.14)

Adjusted R-Square=0.94; Standard Error=0.035; Durbin-Watson=1.55

Distributed Lag on Income

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$	Sum
−1.51*	−0.50*	0.28*	0.82*	1.13*	1.20*	1.04*	0.64*	3.08*
(2.78)	(1.82)	(3.74)	(7.39)	(5.59)	(5.03)	(4.76)	(4.61)	(9.79)

Distributed Lag on Prices

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$
−0.17	−0.23*	−0.27*	−0.31*	−0.32*	−0.33*	−0.32*	−0.30*
(0.99)	(1.96)	(3.75)	(6.21)	(6.15)	(4.85)	(3.97)	(3.42)

$t-8$	$t-9$	$t-10$	$t-11$	Sum
−0.27*	−0.22*	−0.16*	−0.09*	−2.99*
(3.07)	(2.82)	(2.64)	(2.50)	(6.50)

2. Second degree polynomial with the far end point constrained to zero 6 quarters back for the income and cyclical variables, and 10 quarters back for the price variable:

$$lnM_t = -17.04^* + 2.96^* lnY - 2.61^* ln(Pm/Pw) - 1.43^* ln(IP/IPx) + 0.00DSK + 0.03^* D1 - 0.02D2$$
(6.35) (8.21) (4.50) (3.25) (0.01) (2.41) (1.45)

$$+0.03D3$$
(0.26)

Adjusted R-Square=0.87; Standard Error=0.034; Durbin-Watson=1.80;
Auto-Regressive Coefficient=0.45*
(3.30)

Distributed Lag on Income

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	Sum
−1.75*	−0.16	0.91*	1.46*	1.49*	1.01*	2.96*
(2.13)	(0.58)	(6.68)	(4.30)	(3.82)	(3.62)	(8.21)

TABLE 4.
(Continued)

Distributed Lag on Prices

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$
−0.27	−0.30*	−0.32*	−0.33*	−0.33*	−0.31*	−0.27*	−0.23*
(1.04)	(1.82)	(3.22)	(4.50)	(3.82)	(2.95)	(2.41)	(2.08)

$t-8$	$t-9$	Sum
−0.16*	−0.09	−2.96*
(1.86)	(1.70)	(4.50)

3. Second degree polynomial with the far end point constrained to zero 6 quarters back for the income and cyclical variables, and 12 quarters back for the price variable:

$$lnM_t = -18.50^* + 3.15^* lnY - 3.02^* ln(Pm/Pw) - 1.50^* ln(IP/IPx) - 0.01DSK + 0.04^* D1$$
(5.77) (7.34) (4.46) (3.30) (0.31) (2.32)

$$-0.02D2 + 0.01D3$$
(0.90) (0.58)

Adjusted $\bar{R}$-Square=0.87; Standard Error=0.036; Durbin-Watson=1.70;
Auto-Regressive Coefficient=0.37*
(2.28)

Distributed Lag on Income

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	Sum
−1.69*	−0.11	0.95*	1.49*	1.51*	1.02*	3.15*
(2.07)	(0.41)	(6.59)	(4.37)	(3.88)	(3.67)	(3.15)

Distributed Lag on Prices

t	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$
−0.48*	−0.32*	−0.39*	−0.35*	−0.31*	−0.27*	−0.23*	−0.19*
(2.17)	(2.78)	(3.66)	(4.48)	(4.23)	(3.26)	(2.45)	(1.91)

$t-8$	$t-9$	$t-10$	$t-11$	Sum
−0.15	−0.11	−0.07	−0.04	−3.02*
(1.55)	(1.29)	(1.10)	(0.96)	(4.46)

Notes: see Table 2.

Although the introduction of lags and estimation from annual data bring major improvements in our results for the United States, the range of income and price elasticities from various regressions is rather wide. On the income side, the estimated long-run elasticities range from 3.0 to 4.2, while on the price side the long-run elasticities are between −1.4 and −3.8. The cyclical variable yields the negative sign and, in most cases, it is statistically significant at the 90 percent or higher confidence levels. As noted above, these Almon polynomial estimates are somewhat sensitive to the number of lags and the nature of the far end-point constraint.

For Canada and Japan, the short-run quarterly elasticity estimates are about 1/2 and 1/3, respectively, of their long-run values. Thus, the adjustment is nearly complete within a year. This is confirmed by the annual estimates. For the United States, the short-run elasticity estimates are less than 1/4 of their long-run counterparts. The results for annual data and the Almon polynomial estimates indicate that the adjustment of imports to income and price changes takes considerably longer than a year (perhaps as much as three years with respect to prices, although around 90 percent of the effect appears within two years).

TABLE 5. MANUFACTURING IMPORT FUNCTIONS, ANNUAL OBSERVATIONS

	Adjusted R-Square	Standard Error	Durbin-Watson	Serial Correlation Coefficient	Auto Regressive Coefficient	Long-Run Elasticities Income	Long-Run Elasticities Price
Canada (Estimation period: 1962–77)							
$lnM_t = -0.49 + 1.01^* lnY_t$ (0.71) (7.42) $-0.86^* ln(Pm/Pw)_t$ (2.62) $+0.68^* ln(IP/IPx)_t$ (2.84)	0.99	0.032	2.19	—	—	1.01	−0.86
Japan (Estimation period: 1960–77)							
$lnM_t = -11.53^* + 1.37^* lnY_t$ (33.98) (46.36) $-1.50^* ln(Pm/Pw)_t$ (11.40) $+0.82^* ln(IP/IPx)_t$ (6.92)	0.99	0.053	2 19	—	—	1.37	−1.50
United States (Estimation period: 1960–77)							
$lnM_t = -18.89^* + 3.21^* lnY_t$ (6.02) (7.59) $-0.97 ln(Pm/Pw)_t$ (1.17) $-0.05 ln(IP/IPx)_t$ (0.08)	0.88	0.071	1.90	—	0.61* (4.22)	3.21	−0.97
$lnM_t = -16.15^* + 1.31^*(lnY_t + lnY_{t-1})$ (4.29) (4.43) $-1.06^*(ln(Pm/Pw)_t + ln(Pm/Pw)_{t-1})$ (2.62) $-0.51(ln(IP/IPx)_t + ln(IP/IPx)_{t-1})$ (1.61) $+0.33^* lnM_{t-1}$ (2.00)	0.98	0.065	—	−0.25	—	3.91	−3.16
$lnM_t = -11.22^* - 1.79^* lnY_t$ (5.26) (5.37) $-1.61^* ln(Pm/Pw)_t$ (3.64) $-0.43 ln(IP/IPx)_t + 0.58^* lnM_{t-1}$ (1.28) (6.32)	0.99	0.060	—	−0.16	−0.48* (2.15)	4.22	−3.78

Notes: see Table 2.

IV. *Comparison With Other Estimates*

As compared with previous studies, our estimates of long-run income and price elasticities are, in most cases, more robust. In particular, our main estimating equations are statistically highly reliable with both income and price variables appearing as highly significant. This may be partially due to our slightly differentiated specification from those in many previous studies. However, for the most part, this seems to be due to our choice of a more recent time period during which there have been substantial changes in exchange rates. The latter, through their effect on import price variability, make it easier to capture the price effects.

TABLE 6. COMPARISON OF LONG-RUN INCOME AND PRICE ELASTICITIES FOR MANUFACTURING IMPORTS

	Income of Activity					
	Taplin (Annual data, 1953 or 1954 to 1969 or 1970)	Project LINK (Quarterly data, from various bases to 1968 or 1969)	Houthakker and Magee (Quarterly data, 1947–1966)	Magee (Annual data, 1951–1969)	Averages from Tables 3 and 4, (Quarterly data)	Table 5 (Annual data)
Canada	1.4	1.0	—	—	0.9	1.0
Japan	1.8	1.4	—	—	1.3	1.4
United States	2.5	1.7	2.1	2.1	3.0	4.1

	Relative Prices						
	Taplin (Annual data 1953 or 1954 to 1969 or 1970)	Project LINK (Quarterly data, from various bases to 1968 or 1969)	Deppler and Ripley (Semi-annual data, 1964 or 1965 or 1976)	Houthakker and Magee (Quarterly data, 1947–1966)	Magee (Annual data, 1951–1969)	Averages from Tables 3 and 4, (Quarterly data)	Table 5 (Annual data)
Canada	−2.1	−2.5	−0.9	—	—	−0.7	−0.9
Japan	−1.4	−0.7	−1.5	—	—	−1.5	−1.5
United States	−3.0	−0.6	−1.9	−3.3	−3.6	−2.5	−3.5

Sources: Taplin (1973), Project LINK as described in Basevi (1973), Houthakker and Magee (1969), Magee (1975), Deppler and Ripley (1978), and Table 3, 4 and 5 of this paper. Activity variable used in Taplin is the sum of government expenditures, gross fixed capital formation and exports of goods and services. LINK models utilize industrial sector output for Canada and GNP for Japan and the United States. Elsewhere the activity variable is GNP. Both Taplin and LINK classify SITC 5–9 as manufacturing but given the small size of category 9 the distinction is probably inconsequential. For the United States, annual estimates from Table 5 are averages of the last two regressions; and Magee (1975) and Houthakker and Magee (1969) estimates are averages of semi-manufactures' and finished manufactures' elasticities based on 1960 weights of those components.

As shown in Table 6, for Canada and Japan the estimates of long-run income elasticities in this study are generally similar to those in other studies. Our long-run price elasticity estimates for Canada and Japan are virtually identical to those in a recent study by Deppler and Ripley (1978) but substantially different than in the other two studies. However, the estimates in the present study are statistically more reliable than those in earlier studies.

For the United States, our estimates of long-run income elasticity are considerably higher than all others reported in Table 6. This may reflect the differences in observation periods, definitions of activity variables, and our use of cyclical variables. On the price side, our estimates of United States long-run elasticities are substantially higher than the project LINK estimates but roughly similar to other estimates.

Appendix A

Data Sources

Data on real GNP, industrial production, and wholesale prices (industrial goods) were obtained from IMF, *International Financial Statistics*, and used as indexes (1975=100). Manufacturing import volume and unit value series represent SITC 5–8 (only roughly for Canada). These were taken from United States Bureau of Census, Research and Statistics Measures Branch, Foreign Trade Division; Bank of Japan, *Economic Statistics Monthly;* and *Bank of Canada Review*. Annual data on nominal total imports and exports were obtained from IMF, *International Financial Statistics*, while nominal manufacturing import and exports series were taken from U.S. Department of Commerce, *International Economic Indicators*. Nominal manufacturing import series were converted to f.o.b. basis for all countries. Dock strike dummy information for the United States was obtained from the International Finance Division of the Board of Governors.

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