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by

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I. Introduction

The recent advent of a regime of flexible exchange rates has emphasized the need for an understanding of the transmission of exchange rate changes to price changes. The extent and circumstances of the pass through of exchange rate changes to the prices of internationally traded goods has undergone only limited investigation due to theoretical and empirical limitations relevant for such an analysis.[1/] Unlike the view of the international price system which is based on the "law of one price", this paper presents evidence that prolonged divergences between export and domestic price changes for narrowly defined SITC goods[2/] within the United States exist and are influenced significantly by factors predicted by a model of a discriminating monopolist. Theoretically, the elasticity approach, though vulnerable to criticism concerning its partial equilibrium framework, allows a detailed analysis of the effects of exchange rate changes upon the prices of traded goods. The classic graphical analysis, originally presented by G. Haberler[3/], of the effect of an exchange rate change upon the balance of trade, demonstrates the applicability as well as the drawbacks of the elasticity analysis with respect to our interest concerning the price effects of exchange rate changes.

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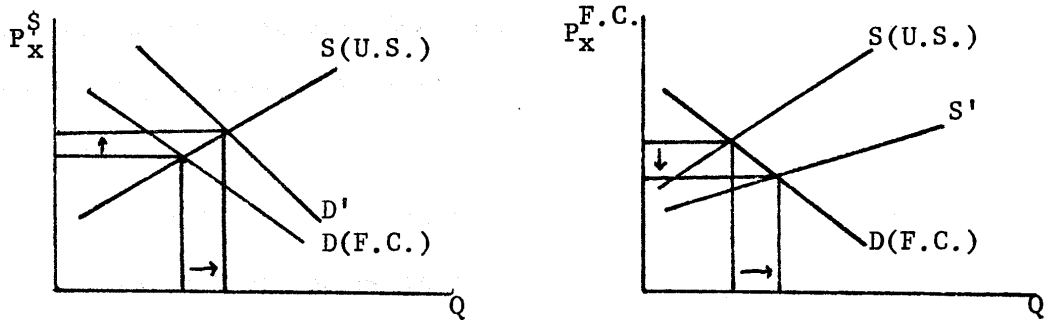
1/ See Magee (1973), Branson (1972), and Kwack (1973).

2/ Standard International Trade Classification, Revised, Statistical Papers, Series M, No. 34 (New York: United Nations, 1961).

3/ Haberler (1949).

In the quantity-adjustment period[4/], a U.S. dollar depreciation, examining the export side expositionally, causes the foreign-country demand [D(F.C.)] for U.S. exports to shift upward in terms of dollars (see Figure I). Correspondingly,

Figure I
U.S. Exports



the U.S. supply of exports shifts downwards in terms of foreign currency. As a result, the buyers-currency price of exports does not decline proportionally to the change in the exchange rate. Rather, the U.S. exporter partially absorbs the dollar depreciation by raising own-currency export prices. By definition, the greater the proportional change in the buyers-currency export price relative to the own-currency export price, given on exchange rate change, the more effective the pass through. As is evident by examining Figure I, the extent of the exporter's adjustment of the dollar export price is determined by the elasticity of export supply (s_x) and by the elasticity of export demand (d_x). Branson[5/] has demonstrated that the dollar export price adjustment is equal to $1-k_x$ where $k_x = \frac{1}{1-d_x/s_x}$.

[4/] Magee (1973).
[5/] Branson (1972).

This paper's main theoretical point of departure from the supply-and-demand analysis in Figure I is that, instead of working within the theoretical framework of a perfectly competitive exporter, the present paper will allow for the possibility that the own-currency domestic price (P^d) and internationally traded price (P^f) of the same good are not equal.[6/] Pass-through literature, neglecting tariffs and transport costs, has assumed implicitly an equality between P^d and P^f. Further, monetarist studies of the purchasing power parity relation take the view that relative real price levels are invariant and that changes in exchange rates and domestic currency price levels are proportional.[7/] Thus, the effect of an exchange rate change upon the pricing strategy of an international monopolistic price discriminator is an area in need of exploration.

[6/] For statistical proof that the "law of one price" does not hold for U.S. Machinery and Equipment see: Kalter (1978), Isard (1976), and Kravis and Lipsey (1978).

[7/] See Frenkel (1978).

II. Data Base

This paper's main empirical departure from previous analyses is that, rather than using export unit values or wholesale prices as proxies for export prices, actual transaction export prices carefully matched to domestic wholesale prices for the same four-and five-digit SITC goods are used in a regression equation specified to capture the potential existence of a discriminating monopolist. As Kravis and Lipsey have demonstrated, the sole availability of unit value data is a limiting factor in any empirical study, as unit value data have proved to be misleading and inaccurate. "The unit value of a trade classification can change, even though all prices are constant, if there is a shift from one quality of item to another.[1/]" Thus the empirical section of this paper uses actual foreign trade prices gathered by a method of Kravis and Lipsey, which places the burden of determining the comparability of products for which prices are compared at two dates upon the respondent.

Export price data have been gained from two sources. First, actual transaction export prices, for sixteen four-and five-digit SITC goods falling within SITC 7: Machinery and Equipment, were obtained for the years 1953 to 1964 from the study by Kravis and Lipsey.[2/] Data were obtained from more than 200 American firms with much attention paid in order to clarify the nature of the price data and to gather information necessary to assign an item to its proper SITC category.

[1/] Kravis and Lipsey (1971).

[2/] Ibid.

The second source of export price data is from the Bureau of Labor Statistics (BLS). In an attempt to gain data comparable to that of the Kravis-Lipsey study, the BLS has collected actual transaction export prices for the same four-and five-digit SITC goods from 1964 to the present via questionnaires similar to those of Kravis and Lipsey.[3/] Wholesale prices of goods that were carefully matched to the export goods were then obtained for the entire period.[4/] Careful attention was paid to using consistent reasoning for including products in this study. The four-and five-digit matched SITC goods that are used in this study are illustrated in Table I.

TABLE I

Four-and Five-Digit SITC Goods Included In Study

#	SITC	Product Name	# Annual Observations
1	711.5	Engines	21
2	712.1	Agricultural Machinery, Cultivating	21
3	712.2	Agricultural Machinery, Harvesting	21
4	712.5	Tractors	21
5	715.1	Machine Tools for Metals	17
6	718.2	Drilling Machines	13
7	718.42	Excavating Machines	10
8	719.1	Heating & Cooling Equipment	21
9	719.2	Pumps, excl. Centrifuges	21
10	719.32	Forklift Trucks	17
11	719.5	Powered Tools	10
12	719.6	Non-Electrical Machinery	10
13	719.92	Valves	19
14	722.2	Electrical Appliances, Electrical Circuits	17
15	725.0	Electrical Household Appliances	21
16	729.52	Electrical Measuring Instruments	10

[3/] Statistical tests have been administered which demonstrated that one cannot reject the null hypothesis (at the 5 per cent level of significance) which is that the two sets of data (BLS and Kravis-Lipsey) are drawn from the same population.

[4/] Further, over one hundred seven-digit SITC goods that are subsets of the four-and five-digit SITC goods were matched to eight-digit domestic goods in Kalter (1978). The regression results obtained from pooling the one hundred seven-digit SITC goods were remarkably similar to those found using the four-and five-digit categories.

To further the match between variables of interest -- and to allow specific economic issues to be tested empirically -- two weighting schemes were computed for each of the sixteen SITC goods. A different forty-five country value-destination weighting scheme was computed for each SITC good. The forty-five countries accounted for a maximum of 97 per cent of the value of destination (SITC 712.2, Agricultural Machinery, Harvesting), and for a minimum of 75 per cent of value destination (SITC 718.42, Excavating Machinery). Secondly, a different seventeen-country competitors' weighting scheme -- accounting for approximately all world exports of the goods -- was computed for each SITC good. Of the sixteen SITC goods, the United States accounted for a minimum of 9 per cent of world exports (SITC 725.0, Electrical Household Appliances) and a maximum of 57 per cent of world exports (SITC 718.42, Excavating Machinery).[5/]

[5/] 1973 weights were used for both weighting schemes.

III. Monopolistic Price Discriminator

The objective of this section is to determine theoretically the effect of a change in the exchange rate upon the relation between the domestic price and the internationally traded price of the same good. If a monopolist sells its product in segmented markets then it will pay him to sell at different prices if the elasticities of demand in the two markets differ.[1/]

The approach used in the following analysis is the standard one of a discriminating monopolist who sells the same good to domestic and foreign residents.[2/] It is assumed that the total market is segmented into two distinct markets. It is further assumed that the product is a differentiated product and therefore only imperfect substitutes are produced abroad.

If a monopolist practices price discrimination in two distinct markets its profit is the difference between the total revenue from both markets and the total cost of production. For the sake of simplicity, we shall assume that production costs are not affected by an exchange rate change. Then:

$$1) \quad \pi = P^{d}_{\bullet}D + P^{f}_{\$}X - C(D+X)$$

1/ The condition of segmented markets implies the existence of imperfect competition as well as barriers to arbitrage. See Dunn (1970), for factors discouraging the arbitrager from taking advantage of international price differentials.

2/ See Clark (1973) and Howe (1976).

where π equals profits, P^d and P^f are dollar domestic and export prices of the same good, D is the domestic quantity and X is the quantity of exports. From first order conditions, we find:

$$2) \quad \frac{d\pi}{dD} = P^d \left[1 + \frac{dP^d}{dD} \frac{D}{P^d}\right] - C\,(D + X) = 0$$

$$3) \quad \frac{d\pi}{dD} = P^f \left[1 + \frac{dP^f}{dX} \frac{X}{P^f}\right] - C\,(D + X) = 0$$

For the discriminating monopolist the marginal revenue in each market must equal the marginal cost of the output as a whole. If the marginal revenues were not equal, the monopolist would increase total revenue without affecting total cost by shifting sales from the low marginal revenue market to the high one. The equality of the marginal revenues implies:

$$4) \quad \frac{P^d}{P^f} = \frac{(1+N^{f-1})}{(1+N^{d-1})} = K$$

where N^f = elasticity of foreign demand, N^d = elasticity of home demand and K = rate of discrimination.

Differentiating K with respect to the exchange rate, and assuming a linearly downward demand curve in both markets, we find that:[3/]

a) If the marginal cost curve is rising then a U.S. dollar depreciation causes both the dollar export price and the dollar wholesale price to rise; the former to a greater degree than the latter.

b) If the marginal cost curve is horizontal then a U.S. dollar depreciation causes the dollar export price to rise. The dollar wholesale price is unaffected by the exchange rate change.

3/ A proof is available upon request, as are the properties of various demand curves.

c) If the marginal cost curve is decreasing then the results are indeterminant.

We may conclude, therefore, that assuming a non-decreasing marginal cost curve, an exchange rate change will change the optimal domestic/export price relationship of an international price discriminator.

The effect of the slope of the marginal cost schedule upon relative price movements of a discriminating monopolist is illustrated in Fugure II. In Figures IIa - IIc, monopolist 'a' has a rising marginal cost schedule and faces a more elastic demand schedule in its foreign market than in its domestic market. Thus, the initial domestic price (P_o^d) is greater than the export price (P_o^f) -- both in terms of domestic currency. Assuming a home-currency depreciation, the foreign demand schedule rotates from D_o^f to D_1^f. The resulting total marginal revenue schedule rotates from MRT_o to MRT_1. As illustrated in Figure IIb, the resulting export price (P_1^f) rises by a greater degree than does the domestic price (P_1^d). Figure IIc illustrates that if the marginal cost schedule shifts due to the larger cost of intermediate goods caused by the depreciation of the home currency then both the domestic and export price again rise. In Figure IId, monopolist 'b' has a constant marginal cost schedule and faces the same domestic and foreign demand schedules as does monopolist 'a'. Before the domestic-currency depreciation, the initial domestic price of monopolist 'a' equals the initial domestic price of monopolist 'b' ($P_{a_o}^d = P_{b_o}^d$) as is true for the export prices ($P_{a_o}^f = P_{b_o}^f$). However, following the domestic-currency depreciation, the domestic price of monopolist 'b' remains unchanged ($P_{b_o}^d = P_{b_1}^d$). Further, the export price rise of monopolist 'b', that is caused by the currency depreciation, is less than that of monopolist 'a' ($P_{b_1}^d < P_{a_1}^d$ and $P_{b_1}^f < P_{a_1}^f$).

Figure II. DISCRIMINATING MONOPOLISTS

Figure II a

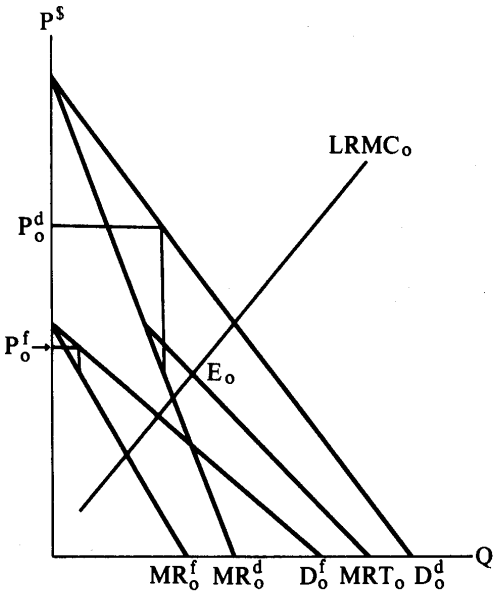


Figure II b

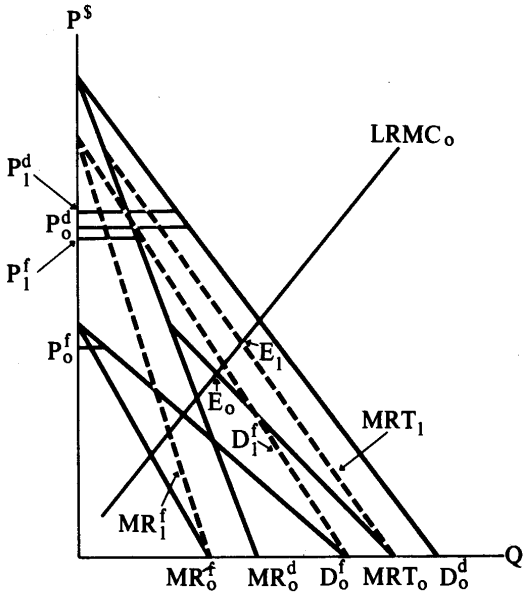


Figure II c

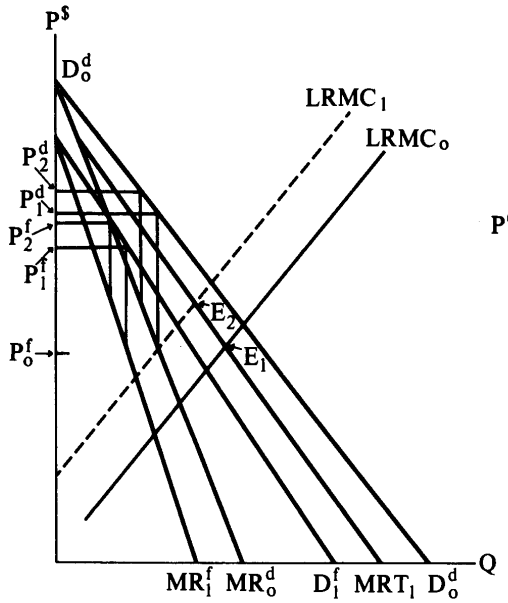
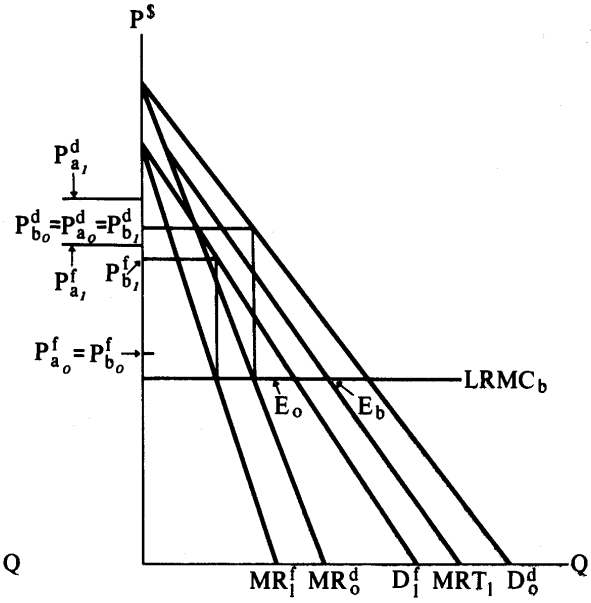


Figure II d



In either case, the effect of the exchange rate depreciation is to lessen the extent of international price discrimination. However, if there had been an exchange rate appreciation or if the foreign demand schedule was less elastic than the domestic demand schedule then the extent of price discrimination would have increased. Further, it is evident that changes in relative prices occur, given an induced shift in the demand schedules, due to changes in the relative elasticities faced by the monopolist.

In order to determine those factors which affect the relation of the export and domestic price of a discriminating monopolist, one might extend the profit-maximizing model developed in equations 1-4. However, this does not lead to an explicit expression for the export price in terms of all exogenous variables. The result of the interdependencies in the model is that "under non-constant returns to scale domestic and export prices are interrelated in such a way that closed form expressions for (P^d and P^f) can not be obtained."[4/] Therefore a mark-up approach is used here where the export price is marked up above domestic costs (proxied by the domestic price) by factors that affect both domestic and foreign demand conditions. As is evident from Figures IIa - IIc, factors that affect the domestic demand schedule will affect both the domestic and foreign price. Those factors that may affect the mark up (γ) on the exported good are:

$$5) \quad \gamma = f(CU^f, CU^d, PC^d, PD^d)$$

where CU^f = foreign capacity utilization rate, CU^d = domestic capacity

4/ See Peter Clark (1973).

utilization rate, PC^d = the U.S. dollar price of foreign goods that compete with the export good and PD^d = the U.S. dollar price of goods in the country of destination of the export good. In equation (5) γ varies positively with CU^f and CU^d while it varies negatively with PC^d and PD^d.[5/]

Those factors that affect the relation between the export price and the domestic price are the arguments of equation (5). Expressing all variables in terms of log differences:

$$6) \ln \frac{\Delta P_t^f}{\Delta P_t^d} = \alpha_o + \alpha_1 \ln \Delta CU_t^d + \alpha_2 \ln \Delta CU_t^f + \alpha_3 \ln \Delta PC_t^d + \alpha_4 \ln \Delta PD_t^d$$

or

$$7) \ln \Delta P_t^f = \alpha_o + \alpha_1 \ln \Delta P_t^d + \alpha_2 \ln \Delta CU_t^d + \alpha_3 \ln \Delta CU_t^f + \alpha_4 \ln \Delta PC_t^d + \alpha_5 \ln \Delta PD_t^d \ \underline{6/}$$

Though both CU^f and CU^d are arguments of equation (5), one would expect (from Section III of this paper) that CU^f would influence P^f by a greater degree than P^d while CU^d would influence P^d by a greater degree than P^f. Thus γ should vary negatively with the difference between CU^d and CU^f. The equation that shall be estimated -- with the expected signs -- is:

[5/] As PC^d = the exchange rate divided by the foreign-currency price of foreign goods that compete with the export good while PD^d = the exchange rate divided by the foreign-currency price of goods in the country of destination of the export good, where the exchange rate is the foreign currency price of the U.S. dollar.

[6/] For example $\ln \Delta PC_t^d = \ln [[R_c^1/PC^{f1}] \div [R_c^o/PC^{fo}]] \equiv \ln [R_c^1/R_c^o] - \ln [PC^{f1}/PC^{fo}]$ where R = foreign-currency price of the dollar and PC^f = foreign-currency price of foreign goods that compete with the export good.

$$8)\ \ln \Delta P_t^f = \alpha_o + \alpha_1 \ln \Delta P_t^d + \alpha_2 \overset{+}{RCU_t} + \alpha_3 \overset{-}{E_t} + \overset{-}{U_t},$$

where $RCU_t = \ln \Delta CU_t^d - \ln \Delta CU_t^f$ and

$$E_t = \tfrac{1}{2} \cdot \ln \Delta PC_t^d + \tfrac{1}{2} \cdot \ln \Delta PD_t^d .$$

E_t is an equal-weighted combination of destination and competitor prices in order to account for both influences while avoiding multicollinearity between the two variables. It is the E_t variable that introduces the relevant exchange rates into the equation.[7/]

7/ For the empirical work found in the next section, CU^d is the U.S. domestic capacity utilization rate created by Artus (1978). CU^f is the weighted-average of foreign capacity utilization rates (Artus 1978). PC^d is a log combination of weighted-average exchange rates and GDP deflators that was created by using the seventeen-country competitor-weighting scheme described in Section II. PD^d is a log combination of weighted-average exchange rates and GDP deflators that was created by using the forty-five country value of destination weighting scheme described in Section II. As mentioned, each of the sixteen four-and five-digit goods has its own weighting scheme due to their individual mix of destinations and competitors.

IV. Empirical Results

Most past studies in international economics have assumed that the "law of one price" applies to shipments destined for home and foreign markets. In the present section, keying on evidence that the law of one price does not hold for goods falling within SITC 7 and that external shocks may have a differential effect upon the domestic and export price of the same good, the specification of those factors which may affect the relation between the export and domestic price of the same good is tested empirically. If it is determined that, indeed, differential effects result, then one may conclude that: (1) Exchange rate changes are one factor explaining worldwide patterns of "dumping" and (2) The pricing of manufactured exports may be explained within the framework of a discriminating monopolistic model. Stemming from this analysis, we should also be able to determine an upper bound for the effectiveness of the pass through of U.S. export prices of manufactured goods over a two-to-three-year period.

A. General Examination of Export and Wholesale Prices and Exchange Rates

This section employs the technique of pooling cross-sectional time-series data in order to test variations of equation (8). Each of the sixteen products listed in Table I is pooled and all obtainable observations are included over time. Before such an analysis is undertaken, it will be useful to gain a general knowledge of the structure of the relative movements of export and domestic prices over the sample period for the products included in this study.

The U.S. dollar "effective" exchange rate appreciated during the 1950's and 1960's and depreciated during the early part of the 1970's.[1/] Thus, ceteris paribus, the ratio of export to domestic prices of goods in 1971 compared to earlier years might be expected to average less than one (one hundred), while the relation might be expected to average greater than one for later years relative to 1971. Table II shows the dollar export price index divided by the dollar wholesale

TABLE II

The Ratio of Export to Domestic Prices in 1971
Relative to Selected Earlier and Later Years

SITC	Product Name	1971 1955	1971 1959	1971 1963	1971 1967	1974 1971
711.5	Engines	103.0	102.3	97.3	96.7	101.3
712.1	Agricultural Machinery, Cultivating	97.5	96.9	100.5	97.7	100.0
712.2	Agricultural Machinery, Harvesting	93.0	96.0	92.1	90.4	93.6
712.5	Tractors	104.7	105.3	103.7	101.3	108.4
715.1	Machine Tools for Metals	N.A.	96.0	95.5	100.0	101.6
718.2	Drilling Machines	N.A.	N.A.	84.0	89.5	93.9
718.42	Excavating Machines	N.A.	N.A.	N.A.	102.1	98.8
719.1	Heating & Cooling Equipment	99.2	95.9	96.0	97.5	97.9
719.2	Pumps, excl. Centrifuges	82.6	86.7	85.6	93.2	97.0
719.32	Forklift Trucks	N.A.	109.0	110.9	107.5	110.2
719.5	Powered Tools	N.A.	N.A.	N.A.	101.7	109.8
719.6	Non-Electrical Machinery	N.A.	N.A.	N.A.	96.0	108.9
719.92	Valves	88.6	96.5	90.4	96.7	88.5
722.2	Electrical Appliances, Electrical Circuits	N.A.	74.2	74.0	95.9	116.2
725.0	Electrical Household Appliances	124.6	120.5	110.5	106.5	103.2
729.52	Electrical Measuring Instruments	N.A.	N.A.	N.A.	95.6	99.3
	Simple Average :	99.2	98.1	95.0	98.0	101.8
	Weighted Average[a/] :	97.8	96.3	93.4	97.8	101.7
	>1 :	3	4	4	5	8
	<1 :	5	7	8	10	7

[a/] 1973 Value Export Weights

price index for particular four-and five-digit SITC goods in 1971 divided by that ratio for the same goods in selected earlier and

[1/] The Federal Reserve Board trade-weighted average value of the U.S. dollar declined by 14.5 per cent between August of 1971 and March of 1973. The trade-weighted U.S. dollar depreciated by 7.1 per cent and 7.4 per cent during 1973 and 1974 respectively and appreciated by 7.7 per cent and 4.6 per cent during 1975 and 1976 respectively.

and later years.[2/] It is evident from the table that, on average, domestic wholesale prices tended to be higher than export prices during the 1953 to 1970 time period while the reverse is true from 1971 to 1975. Of course all other things are not equal and there were many factors affecting relative prices other than exchange rates during the sample period. However, it is evident for the average of the products examined that the pattern of observed relative price movements is not incompatable with observed exchange rate changes.

The change in the relation between export and domestic prices during the early 1970's can be substantiated by employing a succession of "chow tests".[3/] Table III illustrates the results of these tests which were employed in order to determine whether statistically significant structural breaks exist with respect to the relation between export and wholesale price changes over the sample period. The regressions were pooled across the seven products that have a continuous time series during the sample period. The results indicate that throughout the 1960's we cannot reject the null hypothesis which states that the two sets of data (time periods) are drawn from the same population. However, between 1956-1970 and 1971-1975 there exists a dramatic increase in the $F(2,140) = 12.3$. Here, we can reject the null hypothesis at the 1 per cent level of significance which states that the two sets of data are from the same population. If one includes exchange rates in the above regression then the resulting F-statistic drops in all cases. However, the same statistical conclusions result.

[2/] The results are only shown for selected years. However, it is true that the average of the ratios of export to domestic prices of goods in 1971 compared to all earlier years (back to 1953) is less than one while the average of the ratios for the years 1972-1975 over 1971 is greater than one.

[3/] Chow (1960).

TABLE III

Succession of Chow Tests[a/]
(Export Price Change a Function of Wholesale Price Change)
-- Critical F = 4.8 at 1% level of Significance --

Year	Constant	Wholesale Price Change	$\bar{R}^2$	#Observations	SS	Chow
1956-1975	.004(1.5)	.92(20.5)	.75	140	.066006	
1956-1960	.006(2.1)	.80(11.0)	.78	35	.004165	
1961-1975	.004(1.2)	.93(17.5)	.75	105	.061439	0.4
1956-1962	.006(2.8)	.80(13.0)	.78	49	.005596	
1963-1975	.003(.9)	.93(15.7)	.73	91	.059895	0.5
1956-1964	.007(3.8)	.73(11.0)	.66	63	.009501	
1965-1975	.001(.3)	.96(14.6)	.74	77	.054830	1.8
1956-1966	.007(3.7)	.73(11.0)	.61	77	.013029	
1967-1975	.0008(.1)	.97(12.8)	.72	63	.051196	1.9
1956-1968	.007(3.3)	.67(9.3)	.49	91	.020036	
1969-1975	.005(.7)	.95(11.6)	.73	49	.042532	3.7
1956-1970	.007(3.3)	.68(9.7)	.47	105	.025601	
1971-1975	.01 (1.5)	.90(9.7)	.75	32	.030291	12.3

[a/] t-statistic in parentheses

Two observations are evident. First, we have evidence that the relation between export and domestic price changes, for the sixteen SITC products, did not change much during the 1950's and 1960's. This evidence lends more solid ground for including products with different starting dates while pooling cross-sectional time-series data. Second, we have evidence that the relation between export and domestic price changes was significantly different during the first half of the 1970's relative to the preceding two decades. The institution of a regime of flexible exchange rates and a change in the direction of the U.S. dollar effective exchange rate during the early 1970's should have

a predictable affect upon relative export-domestic prices. The regression analysis of this section allows for this by employing "dummy variables" for the post-1970 years.

B. Factors Affecting International Price Discrimination

Sixteen four-and five-digit SITC goods falling within category SITC 7 are pooled into five separate categories: SITC 7, Machinery and Equipment; SITC 71, Nonelectrical Machinery; SITC 72, Electrical Machinery; SITC 712, Agricultural Machinery; and SITC 719, Miscellaneous Machinery. All regressions are in the form of log relatives (log of period t over period t-1).[4/] Table IV illustrates the results of estimating equation (8), where the E variable (equal-weight combination of domestic-currency competitor and destination prices) is lagged one-and two-years and where "slope dummies" (DE) are introduced to determine whether the effect of external price shocks upon relative export-domestic prices changed significantly during the post-1970 period.

Several tests were conducted in Kalter (1978) which demonstrated that perfect arbitrage does not exist for products within category SITC 7. These findings are substatiated by the results illustrated in Table IV where the coefficient on $\ell n \Delta P_t^d$ is always significantly less than one--ranging

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[4/] The method of using relatives tends to reduce the $\bar{R}^2$ values from that resulting from levels equations. However, it also reduces the presence of autocorrelation and thus reduces the chance of observing spurious correlations.

TABLE IV

Discrimination Equations: 1956-1974[a/]

$\ln\Delta P_t^f$	C	$\ln\Delta P_t^d$	RCU	E1	E2	E3	DE1	DE2	DE3	$\bar{R}^2$	#Obs.
SITC 7	.0009	.51	-.15	.02	-.08	-.30				.60	238
	(.4)	(9.4)	(4.0)	(3.3)	(1.6)	(4.5)					
SITC 7a	.008	.44	-.11	.02	.008	-.20	-.03	.15	-.44	.62	238
	(2.5)	(7.7)	(2.7)	(3.1)	(.1)	(2.7)	(.4)	(1.0)	(3.0)		
SITC 71	.004	.43	-.17	-.07	.003	-.29				.60	196
	(1.5)	(7.9)	(4.4)	(1.3)	(.1)	(4.5)					
SITC 71a	.007	.32	-.11	-.18	.05	-.26	.16	.10	-.43	.64	196
	(2.0)	(5.6)	(2.8)	(2.4)	(.8)	(3.7)	(1.6)	(.7)	(3.1)		
SITC 719	-.002	.34	-.23	.01	-.09	-.45				.69	86
	(.5)	(5.2)	(4.1)	(.1)	(.9)	(5.0)					
SITC 719a	.003	.24	-.15	-.11	.001	-.39	.19	.04	-.47	.75	86
	(.6)	(3.7)	(2.7)	(1.1)	(.1)	(3.9)	(1.5)	(.2)	(2.4)		
SITC 712	.007	.57	-.04	-.27	.02	.12				.49	57
	(1.5)	(2.9)	(.6)	(2.4)	(.2)	(.7)					
SITC 712a	.009	.41	-.04	-.35	.05	.05	.006	.22	-.29	.47	57
	(1.2)	(1.6)	(.6)	(2.2)	(.3)	(.2)	(.1)	(.7)	(.9)		
SITC 72	-.01	.78	-.17	.02	-.06	-.45				.61	42
	(1.4)	(3.8)	(1.4)	(2.5)	(.3)	(1.7)					
SITC 72a	-.002	.72	-.12	.02	.02	-.10	-.39	.67	-.80	.60	42
	(.2)	(3.2)	(.8)	(1.7)	(.1)	(.2)	(1.1)	(1.2)	(1.4)		

[a/] The t-statistic is in parentheses. E1 is the contemporaneous equal-weight combination of $\frac{1}{2}\ln\Delta PC_t^d + \frac{1}{2}\ln\Delta PD_t^d$ while E2 and E3 are one-and two-year annual lags. The DE variables are slope dummies of the E variables, representing the years 1970-1974.

from .24(SITC 719) to .78(SITC 72).[5/] We may, thus, conclude that the "law of one price" does not hold for products examined in this study. Table IV also illustrates the coefficients and t-statistics on the RCU variable, which is the difference between U.S. capacity utilization changes and foreign-country capacity utilization changes. The coefficient on the RCU variable is always the correct sign -- that predicted by a model of a discriminating monopolist -- and is significant for goods falling within SITC 7, SITC 71, and SITC 719. Thus if demand pressures are greater abroad than at home, U.S. export prices will rise to a greater extent than matched U.S. wholesale prices.[6/]

Of particular interest in Table IV are the E and DE variables. As mentioned, the E variable introduces the effect of both exchange rate changes in competing and destination countries -- as well as foreign-currency price changes. Both influences were initially included separately -- equivalent to equation (7) -- and both were significant. The combination is used in Table IV in order to give the full effect of external price

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[5/] At the 1 per cent confidence level. Regressions were also run with $\ell n \Delta P_t^f - \ell n \Delta P_t^d$ on the LHS (see equation 6) as well as $\ell n \Delta P_t^f - B^* \ell n \Delta P_t^d$ on the LHS where B^* = estimated coefficient listed in Table IV. When B^* is constrained to be equal to 1 the results are significantly worse than when B^* = estimated coefficients. Further, when B^* = estimated coefficients, the coefficients on the RHS variables are almost identical to those when $\ell n \Delta P_t^d$ is on the RHS. This is an indication that multicollinearity is not a problem for equation (8).

One might expect a multicollinearity problem as the domestic price is affected theoretically by external price shocks, given on upward sloping marginal cost curve. However, two factors mitigate this concern: (1) The sixteen products that are pooled have different annual starting points. This lack of correspondence between time periods should reduce simultaneous equations bias, and (2) For small time-period samples, OLS is superior to TSLS (see Richardson 1971).

[6/] The difference of the capacity utilization variables is used in order to avoid multicollinearity. Further, this specification is intuitively appealing as we are interested in relative price movements. However, we must assume that the total marginal revenue curve is affected similarly by domestic or foreign demand shifts caused by capacity utilization changes.

shocks upon relative export-domestic prices. The sum of the coefficients on the E variables ($\sum E$) represent the change in the amount of international price discrimination caused by external price changes. One finds that it is true for all two-and three-digit SITC categories within SITC 7 that the dollar export price relative ($\ell n \Delta P_t^f$) is negatively related to the external price relatives.[7] This indicates that over a two-to three-year period, an external price change causes the dollar export price to change (in the predicted direction) by a greater extent than the change in the dollar wholesale price. For example, given a 10 per cent increase of external prices, the equation for SITC 7 tells us that the U.S. dollar export price rose by about 3-1/2 per cent more than the U.S. dollar wholesale price (of the same good) during the 1956-1974 period.[8]

For all categories but agricultural machinery (SITC 712), the largest and most significant negative coefficient is lagged two periods. One would expect little relative price adjustment initially as exports of U.S. machinery are generally invoiced in U.S. dollars. It thus appears that rather long lags exist before the discriminating monopolist adjusts its export price to the external price shocks. Further, it is evident from examining the DE variables that the reaction of the firm has changed during the post-1970 years. Due to the greater variance in price and exchange rate changes, the post-1970 reaction of the firm to external

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[7] We expect a negative coefficient as $E = \frac{1}{2}[\ell n[R_c^1/R_c^o] - \ell n[PC^{f1}/PC^{fo}]] + \frac{1}{2}[\ell n[R_d^1/R_d^o] - \ell n[PD^{f1}/PD^{fo}]]$, where R= foreign-currency price of the dollar (weighted average).

[8] For evidence that the effect of external shocks upon relative export-domestic prices looses its significance after two-to three-years, see Kalter (1978).

price changes appears to have been greater than during pre-1970 years. It is also evident that firms have reacted with a longer lag since the institution of flexible exchange rates. Thus for category SITC 71, there exists a significant contemperaneous external price effect for the pre-1970 period while the contemperaneous period looses its statistical significance for the entire 1956-1974 period.[9/]

One is also able to estimate the average effectiveness of the pass through of buyers-currency export prices during the sample period. For example, from SITC 7a, we see that $\sum^{E} = .17$. Thus over a two-to three-year period, a 10 per cent increase of external prices -- expositionally -- caused dollar export prices to rise by about 1.7 per cent more than dollar wholesale prices during the 1953-1970 period. Assuming that wholesale prices were unaffected by the exchange rate change, the pass through was 83 per cent effective. If the dollar wholesale price also rose due to the external price rise then the effectiveness of the pass through was less than 83 per cent.[10/] Again assuming a negligable effect of external price changes upon domestic wholesale prices, during the 1953-1974 time period, the effectiveness of the pass through ranged from 47 per cent (SITC 719) to 87 per cent (SITC 712).

9/ The different results found for the pre-and post-1970 sample period are plausible within the framework of search and information cost theory if it can be assumed that exchange rate changes during the fixed regime period were more fully anticipated than during the flexible regime. The less anticipated the foreign price shock, the longer and more costly the search for the new demand schedule. See Phelps (1970).

10/ If $P^f = C + boP^d + b_1E$ and $P^d = C_1 + a_o\Delta + a_1E$, where Δ is domestic costs, then the effectiveness of the pass through is $[1-(b_o a_1+b_1)]$ which is less than $(1-b_1)$ if E and P^d are related negatively.

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