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UNITED STATES INTERNATIONAL TRADE COMMISSION

FOREIGN TRADE ELASTICITIES FOR TWENTY INDUSTRIES

Investigation 332-65
Under Section 332 of the Tariff Act of 1930

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FOREWORD

This report was prepared by the U.S. International Trade Commission as a part of its investigation 332-65. That investigation was initiated in 1970 at the request of the President, who asked that the U.S. Tariff Commission study the conditions of competition between U.S. and foreign industries and report to him the results of the study. Several reports were completed under this investigation and were forwarded to the President during 1972-73. 1/

On May 9, 1972, the Council on International Economic Policy (CIEP) requested that the Commission continue its work under investigation 332-65 and provide reports on specific topics related to the contemplated negotiations on tariffs and non-tariff barriers under the General Agreement on Tariffs and Trade. The Commission prepared several additional reports in response to the CIEP request, including this report on foreign trade elasticities.

A number of other studies have provided estimates of U.S. import and export elasticities at a fairly aggregated industry level. There is a need, however, for elasticity estimates of trade flows on a disaggregated level, in order that trade comparisons can be made among relatively homogeneous commodity groups. The purpose of this study is to partially satisfy this need by estimating elasticities for a number of 4-digit SIC industries.

This report was prepared principally by Dr. Wayne M. Simon of the Commission's Office of Economic Research.

1/ One of these reports was published as Competitiveness of U.S. Industries, TC Report 473, April 1972. Two other reports dealt with U.S. competitiveness with particular countries, and these reports were not subsequently published.

SUMMARY

Estimates of price and income demand elasticities can be used as guidelines in assessing the impact of changes in trade and tariff policy on the volume of various imported and exported goods. The term "elasticity" is used to indicate the reactions of buyers or sellers in adjusting their purchases or sales in response to a change in an economic variable. 1/ The price and income elasticities of import demand for various commodities provide information on the effect of price and income changes on the level of imports, and they serve as good indicators of future changes in imports resulting from changes in these two variables.

Several criteria were used in this study to select industries which might be most affected by tariff changes. One was the level of duties currently existing on the goods imported, measured here by computing their ad valorem equivalents (see Table 1, page v). This criterion omits most goods with import quotas and imports which might have quite low duty rates but significant non-tariff barriers. Nevertheless, for import price elasticities the height of the duty rate is a good indicator of the range of possible price reductions resulting from a reduction or elimination of the duty. Another important criterion is the degree of existing import penetration into the U.S. domestic market as measured by the import consumption ratio. Most of the industries estimated had

1/ For example, a price elasticity of demand for a particular good of -5 indicates that for a one percent decline in its own price, the quantity demanded for it increases by five percent.

an import consumption ratio of more than ten percent in 1970. In addition, almost all of these industries have been experiencing increases in import penetration of their domestic market (see Table 2, page vi). Such characteristics indicate a particular sensitivity of domestic producers of these commodities to any changes in trade policies affecting them.

The most reliable estimate of the price sensitivity of imports is the price elasticity of the imported product relative to its domestic substitute. The body of this paper describes the two models used for elasticity estimations and the results of each for the industries covered. Also discussed there is the data employed in this study--its uses and limitations. The most significant departure from previous elasticity studies is found in the import price data, where import price series were employed without using unit values, thus overcoming the serious shortcomings of the latter.

The relative price elasticities of imports on an industry basis are presented in Table 3, page vii . They are all in agreement with the idea that as imports become more expensive relative to their domestic substitutes, the quantity of imports demanded declines--assuming other factors are not changing. The same reasoning applies for domestic prices, since it is the ratio of foreign to domestic prices that matters to the purchaser. There is a wide range in the estimates--from -0.089 for Watches and Clocks to -5.494 for Rubber Footwear. As for the reliability of these estimates, all were tested

for statistical significance and most satisfied this test at a reliable level (at the 90 percent confidence level). Thus, these estimates have not been obtained by chance, but rather possess significant explanatory value within the context in which they are used.

The pattern that emerges from the industries covered here is one of an elastic demand of relative prices for the majority of these imports, implying a considerable sensitivity of import buyers to price changes at home and abroad of these goods.

Several policy applications of these import demand elasticities become evident. Tariff rate changes can be converted into approximate future import quantity changes which occur as a result of these duty changes. The interindustry impact of exchange rate variations can be calculated from these elasticity estimates, as can the effects of economic growth on a nation's composition of trade. It should be noted that the use of one elasticity figure such as that for relative prices does not predict what is going to happen to imports. Rather, it is useful for isolating the direct impact of a policy tool (such as a change in import duties). Because other variables are also influencing the pattern of U.S. international trade, it is necessary to look at the specification of the economic relationships involved in order to assess accurately all policy alternatives.

Table 1. U.S. Ad Valorem Equivalents for Selected Industries

SIC NO.	Name of Industry	Ad Valorem Equivalent (in percentage) 1967	1972	Change (-)	Percentage change (-)
2283	Yarn Mills Wool	27.2	24.0	3.2	11.9
2381	Dress & Work Gloves	15.6	12.5[3/]	3.1	20.0
2432	Veneer & Plywood	17.5	14.7	2.8	15.8
2824	Synthetic Organic Fibers, Except Cellulose	19.1	10.8	8.3	43.3
3021	Rubber Footwear	17.5	13.4	4.1	23.3
3111	Leather	10.7	6.3	4.4	41.0
3141	Footwear	15.0	9.4	5.6	37.5
3151	Leather Gloves & Mittens	23.9[1/]	20.3	3.5	14.9
3161	Luggage	19.4	15.0	4.4	22.7
3262 3263	Vitreous China, Table & Kitchen Art. Fine China (Whitewear), Table & Kitchen Articles	41.7	32.7	9.0	21.6
3269	Pottery Products, N.E.C.	25.6[2/]	14.8	10.8	42.2
3421	Cutlery	29.2	16.2	13.0	44.4
3572	Typewriters	.8	.4	.4	50.1
3711	Automobiles	6.5	3.0	3.5	53.8
3871	Watches & Clocks	40.0	22.6	17.4	43.5
3914	Silverware, Plated Ware, & Stainless Steel Ware	27.6	20.7	6.9	25.1
3941	Toys	31.4	15.8	15.6	49.7
3942	Dolls	33.2	18.5	14.6	44.1
3949	Sporting & Athletic Equipment	17.0	9.8	7.2	42.5
3963	Buttons	26.0	16.3	7.2	42.1

1/ 1969
2/ 1968
3/ 1971

Table 2.--Import consumption ratios, 1965-70

SIC Number	1965	1970	Absolute change	Percentage change
2283	6.9	5.1	-1.8	-26.1
2381 1/	15.6	17.8	2.2	14.1
2432	10.2	12.6	2.4	23.3
2824	2.5	3.4	0.9	35.0
3021	14.6	28.6	14.0	95.6
3111	8.5	10.7	2.2	25.7
3141	3.9	13.2	9.3	238.9
3151	30.2	35.1	4.9	16.3
3161	3.1	9.0	5.9	191.9
3262 & 3263	31.4	43.1	11.7	37.4
3269	22.7	28.1	5.4	23.5
3421	9.0	10.7	1.7	18.8
3572	13.9	14.4	0.6	4.1
3711 2/3/	7.2	14.7	7.5	104.0
3871	16.0	18.7	2.7	17.0
3914	8.2	12.4	4.2	51.4
3941	5.4	10.2	4.8	89.0
3942	10.9	17.3	6.4	58.9
3949	7.0	15.4	8.4	120.0
3963	8.5	11.7	3.2	37.1

1/ 1967 data used which includes part of 2259.
2/ Shipments figure includes substantial duplication.
3/ 1967 data used.

Table 3.--Estimates and Rankings of U.S. Import Demand Elasticities

SIC	Industry	P_i/P_d	Rank (P_i/P_d)
2283	Yarn Mills Wool (1/66-3/71)	-1.915	11
2381	Fabric Dress & Work Gloves (1/66-4/71)	-0.9241	15
2432	Veneer and Plywood	-0.5804	18
2824	Synthetic Organic Fibers (1/66-3/71)	-5.462	2
3021	Rubber Footwear	-5.494	1
3111	Leather (1/67-4/72)	-2.423	8
3141	Footwear (1/66-4/72)	-4.3079	3
3151	Leather Gloves & Mittens (1/69-4/72)	-4.060	4
3161	Luggage	-1.815	12
3262) 3263)	Vitreous China Food Utensils & Fine China, Table and Kitchen	-1.0257	14
3421	Cutlery	-0.6672	17
3572	Typewriters (1/65-4/72)	-0.9239	16
3711	Passenger Cars (1/67-4/72)	-2.336	9
3871	Watches & Clocks	-0.089	19
3914	Silverware, Plateware and Stainless Steel	-2.699	5
3941	Toys and Games (1/67-4/72)	-2.553	7
3942	Dolls	-2.258	10
3949	Sporting & Athletic Goods, N.E.C.	-1.450	13
3963	Buttons	-2.678	6

P_i/P_d = Relative price elasticity of import to domestic substitute.

3269 not included in this table because a domestic price index was not available.

These regressions have been estimated using quarterly data from 1966 to 1972, unless otherwise noted.

EXPLANATION OF THE ELASTICITY ESTIMATES

Specification of the regression equations and discussion of the variables used

Two basic equations are used in estimating import demand structure by commodity on a four-digit SIC level. One utilizes the actual prices of imports and of their principal domestic substitutes. It is formulated as follows:

$$(1) \quad \log (V_m/P_i) = \log Q_m = a_0 + a_1 \log P_i + a_2 \log P_d + a_3 \log ACT$$

where:

V_m = value of imports

Q_m = quantity of imports

P_i = import price

P_d = domestic price

ACT = activity variable

This equation has the advantage of showing changes in the level of U.S. imports from the world due to changes in the prices of imports and of their close domestic substitutes. Using relative prices obscures these changes, because imports may decline due to a general rise in the prices of the commodity, both foreign and domestic, while the relative price may change little. 1/

An alternative to the above specification, one which would not change its basic relationship, would be to deflate the price variables by a general price index. The U.S. composite Wholesale Price Index (WPI) was tried as a proxy for this, but the experiment generally did not result in any improvement in the estimation--more often, the R^2 in this specification was inferior to that obtained in equation (1). This may

1/ Edward E. Leamer and Robert M. Stern, Quantitative International Economics (Boston: Allyn and Bacon, Inc., 1970), p. 9-10.

be due to the need for a better measure of general prices for use in relation to specific commodity prices. Or the explanation might run along the following lines (at least for the 1960's and 1970's): When purchasers consider a specific import commodity, their price comparisons focus chiefly on the prices of that commodity and of substitutes. Hence, it is misleading to deflate a commodity price series by a general price index, for the basis of comparison is not primarily between the specific good and all goods. Rather, it seems more likely that the comparison is between that good and a bundle of closely related domestic substitutes. Whatever the explanation, more research and empirical testing are needed to assess whether there is an adequate price measure for use as a deflator.

The other basic equation employed in the import demand estimations relies on the relative price of the imported good vis-a-vis the domestic substitute good. Its specification, frequently used in existing trade literature is as follows:

$$(2) \qquad \log (V_m/P_i) = \log Q_m = a0 + a_1 \log (P_i/P_d) + a_2 \log ACT$$

Here, the relative foreign-domestic price ratio of the good, rather than the actual price levels of the good, imported and domestic, is considered the critical price variable. Again, there is no comparison with a general price level.

Both of these equations are premised on a continuing differential in the prices of imports and of their domestic substitutes. One of the basic assumptions employed here is that there is some type of product

differentiation, real or imagined, based upon origin of the good. 1/ In a world of imperfect knowledge as well as of varying consumer tastes, such an assumption is not unrealistic. Other factors may be responsible for price deviations between the domestic and foreign goods, but these are of a more transitory nature. They result from the different rates of inflation occurring in various countries and from government policies in the international realm, such as adjusting exchange rates or changing tariff rates. However, in the absence of any product differentiation or of market imperfections, one would expect international and domestic prices for a commodity generally to be the same. That these prices do diverge is a reflection of the differentiation of these products and of market imperfections.

Aside from the different manner in which prices are specified, equations (1) and (2) are similar. Both are log-linear equations, the most convenient and common type used in estimating elasticities, as the resulting coefficients are the elasticity measures. Both equations use an activity variable which represents economic "income" forces influencing import demand. For industries where the imports may be inputs into other industries, an activity variable reflecting the level of production in these industries was constructed. 2/ Otherwise, real GNP was used as a proxy for the level of economic output (and income). When a constructed

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1/ Paul S. Armington, "A Theory of Demand for Products Distinguished by Place of Production," International Monetary Fund, Staff Papers, Vol. XVI, No. 1 (March 1969), pp. 159-76.

2/ The two basic data sources employed are: (1) the various issues of Business Statistics and Survey of Current Business published by the U.S. Department of Commerce; and (2) Industrial production indexes published by the U.S. Board of Governors of the Federal Reserve System.

activity variable was employed, a comparison was made between the equation using that variable and an equation using GNP instead. In most cases, GNP performed more satisfactorily than did the activity variable. The only industries basically producing an intermediate good which finally utilized GNP rather than a constructed activity variable are (1) Veneer and Plywood, and (2) Synthetic Organic Fibers. This may be due to insufficient data for constructing an appropriate activity variable or it may be that the imports of these industries are highly dependent on the level of U.S. economic activity.

The principal improvement in the elasticity estimates of this study compared with previous estimates lies in the data base employed for prices. To escape from the known inadequacies of unit value indexes, a time series for U.S. import prices for each commodity studied was constructed without using unit values. This was accomplished by utilizing foreign export price indexes for the commodities being studied, along with comparably defined prices obtained from some major U.S. importers. These price indexes were then adjusted for exchange rate changes and tariff adjustments to convert them into U.S. import prices indexes. 1/ They thus have the virtue of being indexes that, unlike unit-value indexes, are unaffected by changes in the composition of imports in the four digit SIC categories. Unit values are notorious for changing in

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1/ The tariff adjustments involved estimating the ad valorem equivalent for each four-digit SIC product group on a quarterly basis for the time period involved.

Scarcity of data precluded any attempt to estimate changes in transport costs; hence, they must be assumed to have been fairly constant during the period under consideration.

response to shifting commodity composition as well as in response to price variations.

Data were available for various export commodities from Japan, West Germany, Taiwan, Switzerland, and The Netherlands. As these countries are among the major exporters of goods to the U.S. market, their export price series for individual commodities were considered to give a fairly broad coverage representative of U.S. import prices in the industries under consideration. For those few commodities which these countries do not supply in large amounts to the U.S. market, the relevant price series were tested for representativeness of world trade prices. When export prices were available from several countries for a given import category, they generally were combined by weighting according to their shares of U.S. imports in 1969, unless it was felt that regional weights would be more representative.

The basic equation specifications described above apply to all import functions estimated here. Variations from these two basic models included adjustments (either using dummy variables or correcting the data for seasonal influences) to account for seasonality in the quarterly data and for the effects of dock strikes in the U.S. in 1969 and 1971. These variables were included only if they contributed significantly (at the 95 percent level or higher) to the overall explanatory value of the equation.

Coverage of the estimates

The industry sample chosen here was selected on the basis of various criteria. The two most important ones were a fairly high import consumption ratio (generally higher than 10 percent) and a rising import

consumption ratio in recent years. Neither of these was necessarily an absolute requirement for estimation, but most industries selected satisfied these criteria, indicated in Table 2, page vi. These domestic industries, then, face substantial and increasing import competition for the U.S. market. Another objective in the selection of industries was to achieve a representative sample of U.S. industries, covering a variety of consumer goods as well as some industrial products. This was done within the constraints of data availability and the ability to compute ad valorem equivalents for the industries. Unfortunately, industries such as the textile industries could not be given much coverage due to the U.S. quota system. Nevertheless, a wide variety of "import sensitive" industries is covered in this study.

Results of the calculations

The results of the estimations are presented in Table 4. Almost all of the signs are what one could expect, a priori. In addition, the coefficients of each of the variables are often significant at the 95 percent level and are in a numerical range which can be considered reasonable. The histograms in Figures 1 through 5 give an idea of the range of the elasticity values which were computed for each of the explanatory variables in the two equations.

Both the import price elasticities of demand from equation (1) and the relative price elasticities of equation (2) evince a similar pattern. The average for the commodities covered lies between -2.0 and -2.5, and about one-fourth of the commodities are judged inelastic in their price responsiveness. Hence, the majority of import commodities in this

Table 4.--Estimates of U.S. Import Demand Elasticities

SIC	P_i	P_d	ACT	P_i/P_d	A_o	Q_2	Q_3	Q_4	DSD69	DSD71	R^2	SEE	D-W
2283 Yarn Mills Wool			1.696+	-1.915*	3.478				-0.459*		0.5674	0.1718	1.86
(1/66-3/71)	-2.323	1.902*	1.7794+		5.134				-0.4629*		0.5701	0.1762	1.89
	(-1.647)	(2.639)	(3.188)		(0.9448)				(-2.446)				
2361 Fabric Dress and Work Gloves			2.102+	-0.9241	-3.040	0.3144+	0.8695+	0.4367+			0.9174	0.1172	2.27
(1/66-4/71)	-0.7037	2.980*	-0.6771		4.551	0.3156+	0.8857+	0.4565+			0.9298	0.0124	2.53
	(-1.286)	(2.293)	(-0.400)		(0.8063)	(4.905)	(13.439)	(6.627)					
2432 Veneer and Plywood			6.7938+	-0.5804	-31.44						0.7822	0.2435	1.08
	-1.8304	0.5918	7.291+		-28.86						0.7893	0.2444	1.22
	(-1.260)	(1.425)	(6.723)		(-4.265)								
2824 Synthetic Organic Fibers			2.013	-5.462+	-0.1725				-0.5795+		0.8644	0.1620	1.07
(1/66-3/71)	-5.2469+	6.610+	3.125		24.39				-0.5823+		0.8678	0.0270	1.04
	(-4.071)	(3.138)	(1.365)		(0.9142)				(-3.427)				
3021 Rubber Footwear			2.787+	-5.494+	-5.123						0.9231	0.1381	2.54
	-5.3508+	5.7414+	2.322		-3.914						0.9236	0.0197	2.56
	(-6.124)	(5.756)	(1.703)		(-0.6535)								
3111 Leather (1/66-3/71)			-0.329	-2.423+	13.85					-0.1951	0.4649	0.1026	0.75
	-1.658+	2.500+	0.680*		5.239					-0.1419	0.7918	0.0657	1.58
	(-3.588)	(5.676)	(2.410)		(2.829)					(-2.009)			
3.11 Footwear (1/66-4/72)			6.063+	-4.3079+	-2.60						0.8543	0.1505	1.68
	-3.450+	7.376+	0.558		-8.278						0.8908	0.1335	2.23
	(-4.974)	(3.69)	(0.253)		(-1.066)								
3151 Leather Gloves and Mittens			4.257*	-4.060+	-8.162	0.5932+	1.312+	1.2997+			0.9486	0.1552	1.78
(1/69-4/72)	-2.856*	0.1328	3.161		9.358	0.6052+	1.298+	1.2906+			0.9598	0.1448	2.37
	(-2.522)	(0.051)	(1.969)		(0.7208)	(5.138)	(9.326)	(8.965)					

Table 4.--Estimates of U.S. Import Demand Elasticities--Continued

SIC	P_i	P_d	ACT	P_i/P_d	A_o	Q_2	Q_3	Q_4	DSD69	DSD71	R^2	SEE	D-W
3161 Luggage			6.952+ (5.855)	-1.815 (-1.091)	-34.41 (-4.454)						0.7421	0.1596	1.72
	-1.8808 (-1.006)	2.0922 (0.584)	6.786+ (3.016)		-34.29 (-4.248)						0.7422	0.1644	1.73
1/ 3262 Vitreous China Food Utensils & 3263 Fine China, Table and Kitchen			2.0251+ (3.832)	-1.0257* (-2.586)	-0.8928 (-0.2537)					-0.3209* (-2.408)	0.6990	0.1236	1.25
	-1.958+ (-3.063)	0.0537 (0.076)	5.4428* (2.787)		-13.67 (-1.749)					-0.3596* (-2.657)	0.7366	0.1181	1.34
2/ 3269 Pottery Products, N.E.C. (1/68-4/72)	-0.3412 (-1.128)		4.2684+ (3.183)		-15.09 (-2.009)						0.6227	0.0103	1.94
3421 Cutlery			2.1228+ (6.040)	-0.6672+ (-3.143)	-2.431 (-1.073)					-0.2843+ (-4.164)	0.7068	0.0647	2.18
	-0.6807+ (-3.130)	0.873 (1.846)	1.9483+ (3.856)		-2.173 (-0.9198)					-0.2880 (-4.127)	0.7098	0.0657	2.18
1/ 3572 Typewriters (1/65-4/72)			3.243+ (8.178)	-0.9239 (-1.541)	-13.68 (-5.274)						0.7224	0.1618	1.62
	-1.024 (-1.953)	9.348+ (3.448)	1.063 (1.385)		-33.07 (-3.760)						0.7956	0.1415	2.08
3711 Passenger Cars (1/67-4/72)			8.145+ (6.536)	-2.336* (-2.329)	-38.29 (-4.550)						0.7309	0.0399	1.34
	-2.445+ (-3.153)	7.299+ (4.832)	4.146+ (2.871)		-34.57 (-5.226)						0.8450	0.0263	2.07
3871 Watches & Clocks			0.992+ (4.571)	-0.089 (-0.514)	6.135 (4.364)	0.159+ (4.990)	0.207+ (6.485)	0.4223+ (13.205)			0.9120	0.0591	2.11
	-0.1360 (-0.462)	-0.029 (-0.047)	1.125 (1.602)		6.039 (3.985)	0.159+ (4.879)	0.2070+ (6.534)	0.4212+ (12.695)			0.9121	0.0604	2.00
3914 Silverware Plateware and Stainless Steel			6.257+ (5.965)	-2.699+ (-4.142)	-29.90 (-4.336)						0.6778	0.3206	1.49
	-1.583 (-1.004)	3.823* (2.410)	1.960 (0.349)		-12.18 (-0.5120)						0.6857	0.3232	1.64

Table 4.--Estimates of U.S. Import Demand Elasticities--Continued

SIC	P_i	P_d	ACT	P_i/P_d	A_o	Q_2	Q_3	Q_4	DSD69	DSD71	R^2	SEE	D-w
3941 Toys and Games (1/67-4/72)			3.935+ (10.109)	-2.553+ (-5.660)	-13.18 (-5.154)	0.2941+ (5.465)	0.6112+ (11.283)	0.3677+ (6.714)			0.9430	0.0929	1.34
	-2.657+ (-5.395)	2.063* (2.159)	4.502+ (4.298)		-14.11 (-4.617)	0.2959+ (5.388)	0.6081+ (10.991)	0.3648+ (6.510)			0.9244	0.0946	1.40
3942 Dolls			4.828+ (6.920)	-2.258* (-2.385)	-19.93 (-4.401)	0.3372+ (3.124)	0.6813+ (6.278)	0.4937+ (4.504)			0.8239	0.2015	0.69
	-5.255+ (-4.265)	1,793* (2.216)	6.394+ (8.357)		-13.47 (-3.123)	0.3281+ (3.614)	0.6724+ (7.370)	0.5178+ (5.601)			0.8813	0.1694	1.21
3949 Sporting & Athletic Goods, N.E.C.			6.940+ (12.228)	-1.450* (-2.157)	-32.86 (-8.918)						0.8693	0.1530	1.02
	0.259 (0.532)	5.759+ (7.427)	3.274+ (4.973)		-36.91 (-19.80)						0.9535	0.0935	2.41
3963 Buttons			0.331 (1.066)	-2.678 (-6.214)							0.7606	0.1217	1.60
	-2.328* (-2.379)	2.680+ (6.14)	0.3572 (1.108)								0.7622	0.1238	1.57

1/ This industry was estimated after adjusting the independent variables for seasonality. Method of quarterly seasonal adjustment is that employed by the Census Bureau.

2/ For this industry no comparable domestic price series exists.

t - values shown in parenthesis.

For significance of estimates of dependent variables, the following symbols are used:

* Estimate significant at the 95 percent level.
\+ Estimate significant at the 99 percent level.

Table 4.--Estimates of U.S. Import Demand Elasticities--Explanatory Notes--

P_i = Price elasticity of imports

P_d = Price elasticity of domestic substitute

ACT = Activity variable--GNP is the activity variable used except in the following industries:

2283 - Used Men's and Women's Ready to Wear
3111 - Used Finished Leather Products
3151 - Used Finished Leather Products
3963 - Used Apparel Cuttings

A_o = Intercept constant

Q_i (i=2,3,4) = Seasonal dummy variables

DSD69 & DSD 71 = Dock strike dummy variables for 1969 and 1971

SEE = Standard error of estimate

D-W = Durbin-Watson statistic

These regressions have been estimated using quarterly data from 1966 to 1972, unless otherwise noted.

FIG. 1: IMPORT PRICE ELASTICITIES

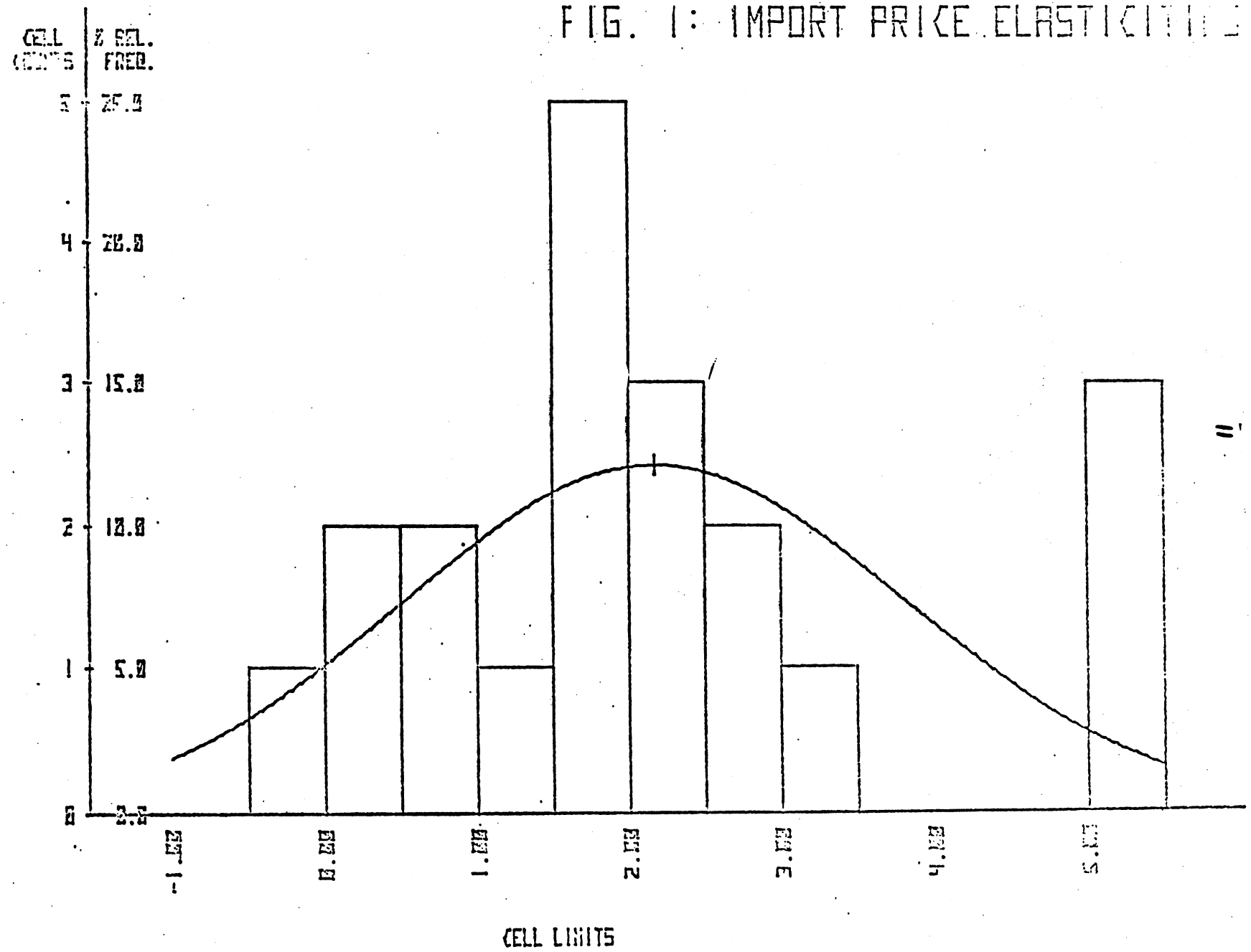


FIG. 2: DOMESTIC PRICE ELASTICITIES

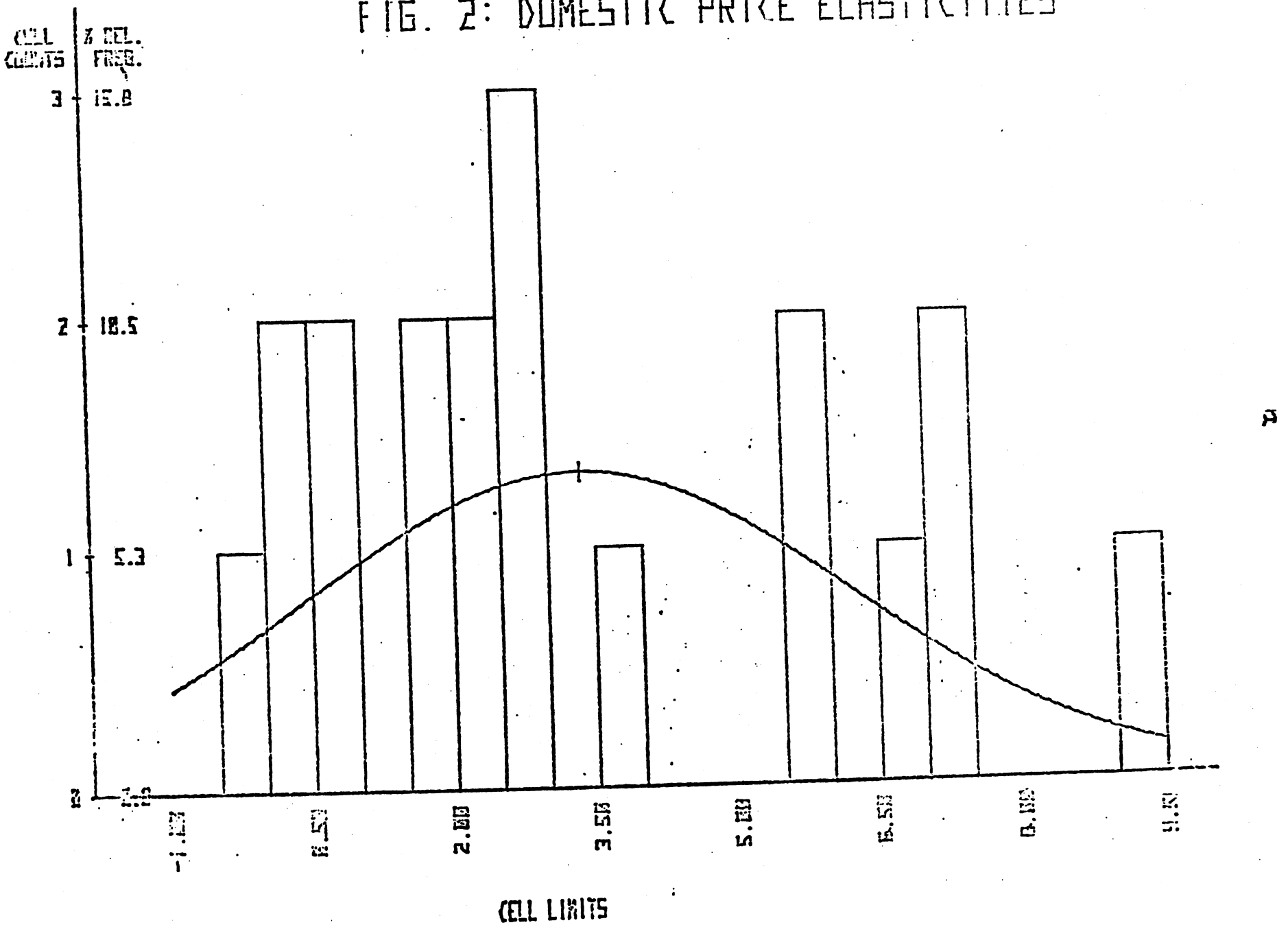


FIG. 3: ACTIVITY VARIABLE

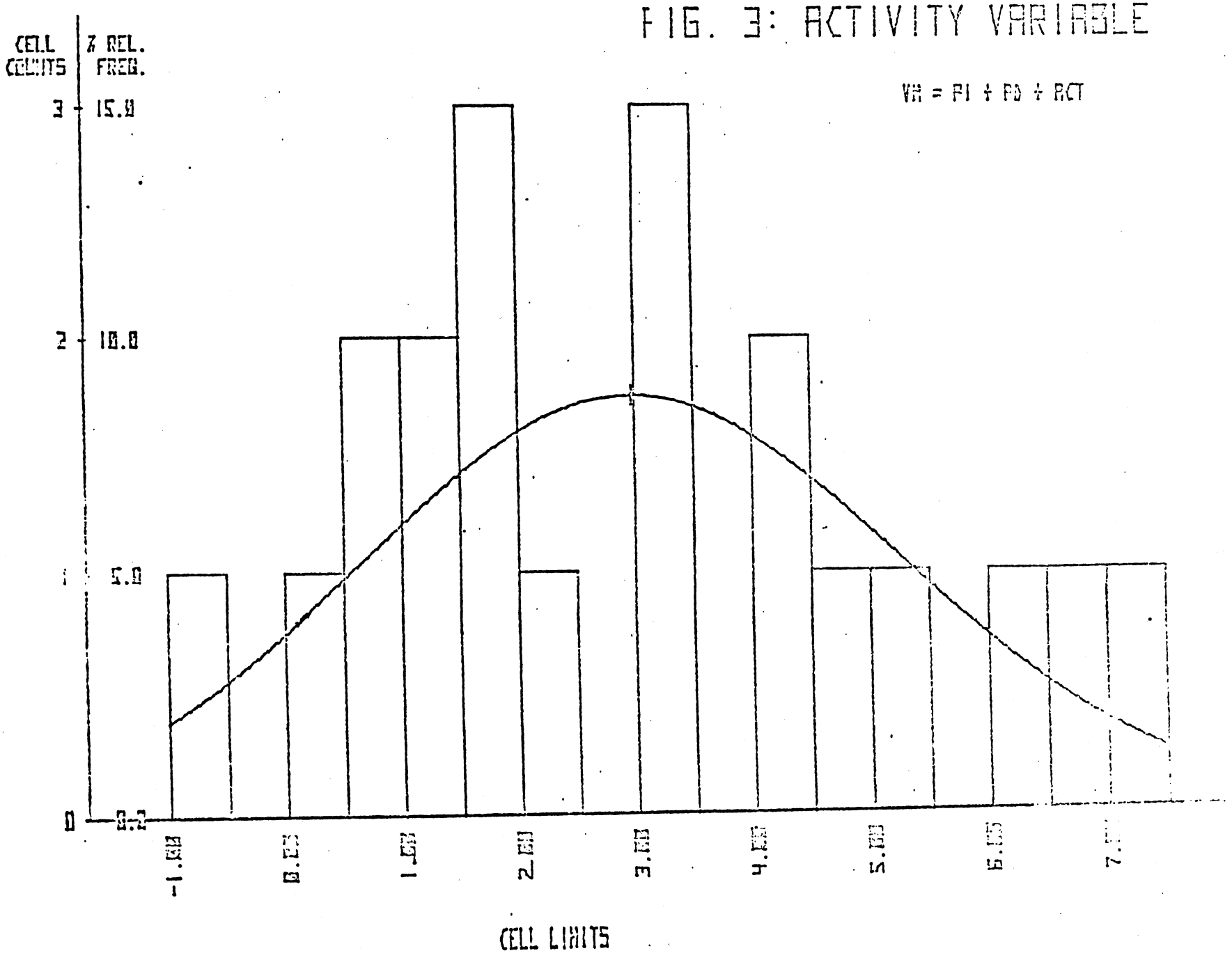
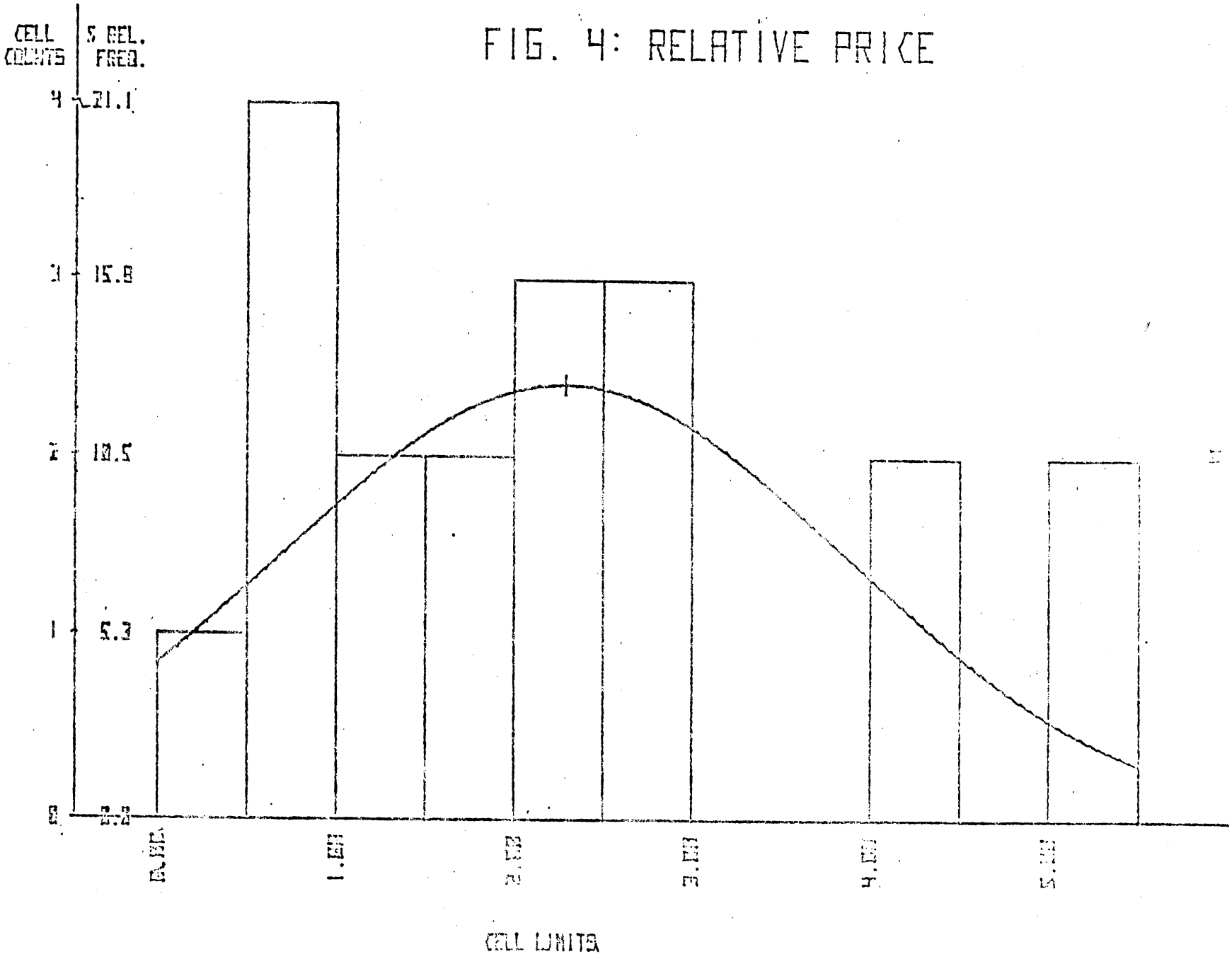


FIG. 4: RELATIVE PRICE



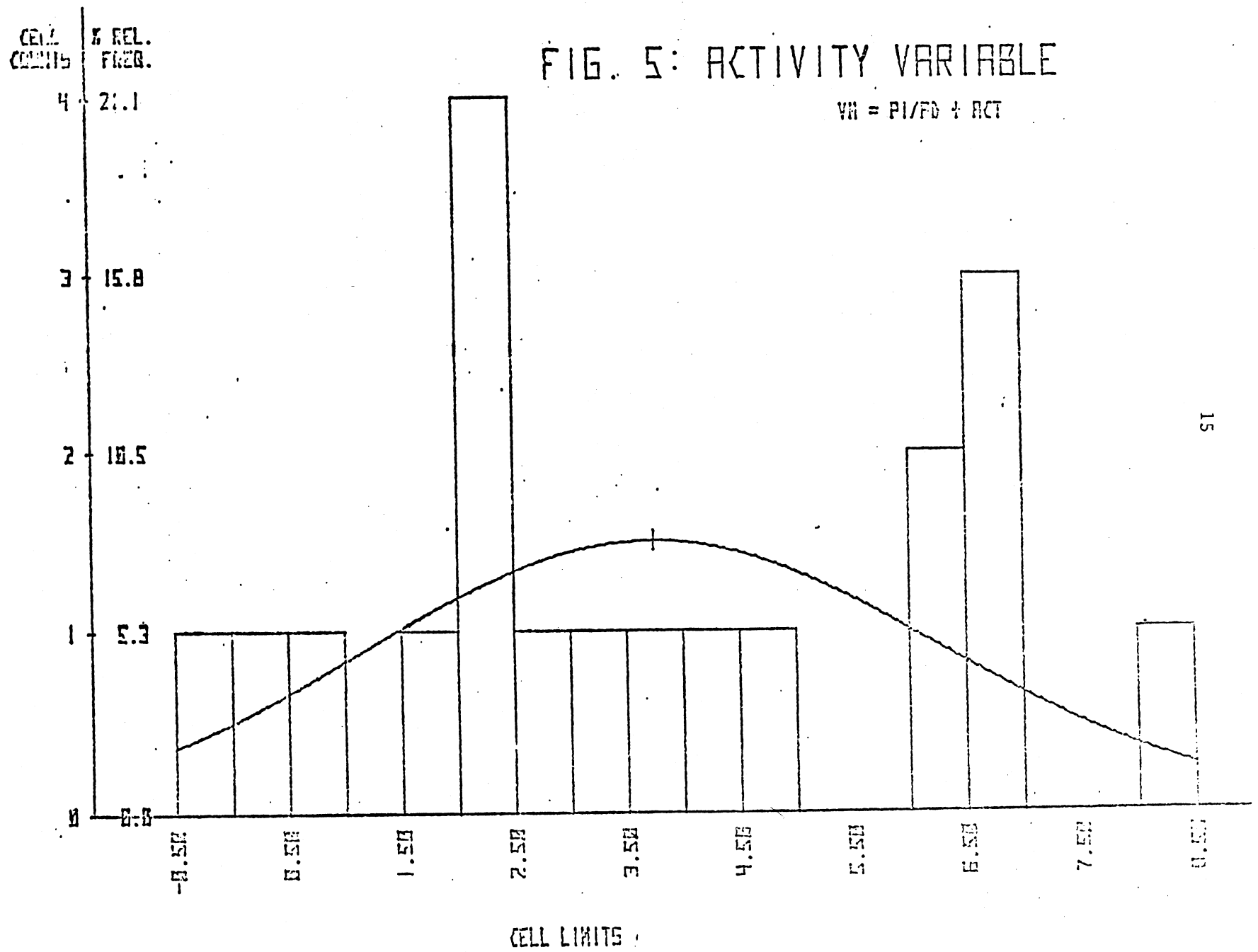


FIG. 5: ACTIVITY VARIABLE
VR = PI/FD + ACT
CELL COUNTS
% REL. FREQ.
4
21.1
3
15.8
2
10.5
1
5.3
0
0.0
-0.5
0.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
CELL LIMITS

sample, which represents many of the most import-sensitive U.S. industries, display elastic import price tendencies. Some industries appear to be quite price elastic.

The quantity of imported goods seems to be even more sensitive to domestic price changes of substitutes than to changes in their own prices. To some extent this might be explained by reasoning that purchasers tend to spend a greater proportion of their income on the domestic product than on the imported substitute. If this is the case, then a price change of the domestic good would amount to a greater proportion of the purchasers' outlays than would an equal percentage price change of the imported good. As the histogram of the domestic price elasticities shows (Figure 2), these industry estimates have a mean close to 3.5, an average considerably higher than the absolute value for their foreign price counterparts. The average mean is raised by some fairly high domestic price elasticities, and this mean might have been smaller with a larger sample.

Finally, the activity variables appear to indicate a high degree of sensitivity in influencing imports. In equation (1) the average elasticity value is about 3, whereas in equation (2) it lies between 3.5 and 4. As the histograms of both equations show (Figures 3 and 5), the majority of these estimates lie in the "income" elastic range reflecting the desire of consumers (and producers) to alter their percentage of outlays on products from abroad as their income (and as economic activity) rises. If these are accepted as representative of U.S. industries, then

this pattern helps explain a basic problem with the U.S. balance of trade. As the domestic economy grows over time, and assuming that this pattern of high "income" elasticity of import demand continues, a trade balance can remain positive only as exports grow at least as fast, implying an increasing proportion of U.S. production for exports. Implicit in this discussion is a very high price elasticity (hopefully infinite, or almost so) of foreign supply of export commodities, so that changes in U.S. import demand for a commodity due to price or "income" factors will be fully reflected in the actual quantity of imports.

A further perspective on the results present in this paper is gained by observing the ranking of the different industries by their import price elasticities, as shown in Table 5. The figures in column P_i represent the magnitude of the import price elasticity of each industry relative to the other industries included in the table. Thus, rubber footwear with an elasticity of -5.35 has the highest ranking, whereas the item watches and clocks with an elasticity of -0.089 has the lowest ranking. In column P_i/P_d the same industries are ranked in descending order of magnitude for relative price elasticities. 1/

Those industries showing the greatest import price sensitivity are footwear (leather and rubber), synthetic fibers, and leather gloves, whereas much less import price sensitivity appears to be associated with fabric dress and work gloves, watches and clocks, cutlery, and typewriters. The other imports fall somewhere between these extremes, having a price

1/ The Spearman rank correlation coefficient, after deleting industries 3269 and 3949, is 0.77, which is significant at the 99 percent level.

Table 5.--Rank from largest to smallest elasticities

SIC	Industry	Price		Income	
	Equation number:	(1) (P_i)	(2) (P_i^2/P_d)	1	2
2283	Yarn Mills Wool	9	11	14	16
2381	Fabric Dress & Work Gloves	16	15	3/	13
2432	Veneer and Plywood	12	18	1	4
2824	Synthetic Organic Fibers	3	2	10	15
3021	Rubber Footwear	1	1	11	11
3111	Leather Tanning & Finishing	13	8	17	3/
3141	Footwear	4	3	18	6
3151	Leather Gloves & Mittens	5	4	9	8
3161	Luggage	11	12	2	2
3262) 3263)	China - Vitreous and Fine	10	14	4	14
3269	Pottery Products, N.E.C.	18	1/	6	1/
3421	Cutlery	17	17	13	12
3572	Typewriters	15	16	16	10
3711	Passenger Cars	7	9	7	1
3871	Watches and Clocks	19	19	15	17
3914	Silverware, Plateware and Stainless Steel	14	5	12	5
3941	Toys and Games	6	7	5	9
3942	Dolls	2	10	3	7
3949	Sporting and Athletic Goods, N.E.C.	2/	13	8	3
3963	Buttons	8	6	19	18

1/ Lack of domestic price data for this industry does not permit estimation of P_i/P_d or of activity variable

2/ The estimate here was a "positive" elasticity, therefore not comparable with the other data.

3/ The estimate here was a "negative" elasticity, therefore not comparable with the other data.

elastic demand. This information can be useful to policymakers, particularly in assessing the relative impact of equal tariff rate changes or exchange rate adjustments on different goods. For example, if a comparisone of the import price elasticities of two industries showed one with a substantially higher elasticity than the other, then it would be reasonable to suppose that an equal tariff reduction in both industries would have a greater impact in the more price sensitive industry.

Rankings of the elasticities of the activity variables also give a fairly good idea of the relative sensitivities of the imports of these industries to "income" changes. The Spearman rank correlation of 0.5613 is significant (here, at the 95 percent level), indicating that both equation specifications give similar results in making inter-industry comparisons of "income" elasticities of demand for imports. To some extent, then, the industries with fairly high elasticities will be those which can expect a considerable degree of import competition, barring any major changes in domestic or foreign prices or in purchasers' tastes.

Limitations of the analysis

The elasticity estimates presented here are generally reasonable ones and indicate fairly reliably the nature of the responsiveness of imports to price and activity variables. They do have some limitations in their use, however. There are problems of autocorrelation and of multicollinearity in some of the equations, which reduce confidence in the affected coefficients. The Durbin-Watson statistic is included in Table 4. For most of the equations, it is not necessary to accept the hypothesis of

autocorrelation. The degree of severity of multicollinearity in these equations is indicated in Table 6, which uses the tests developed by Farrar and Glauber in determining this severity. 1/ Not unexpectedly, the problem shows up more often in the absolute price equations than in the relative price equations. In fact, all of the former show a great deal of intercorrelation among the explanatory variables. This is probably due to the tendency in many industries for domestic and foreign prices to move together.

There is a justification for estimating imports using some type of lag specification for the independent variables. The Almon distributed lag technique was tried for many of these industries. Most of the results were unsatisfactory, giving either a random lag structure for the variables which did not accord at all with a priori expectations, or long term elasticities of the wrong sign. The major difficulty here appears to be a lack of sufficient observations for these industries. This may be rectified as more observations become available.

Other possible limits of the approach used in this study relate to data comparability as well as to equation specification. The latter issue has been well explored in the literature. For a multi-equation specification, data for a world supply function, or even individual country export supply functions, for these commodities would need to be available on a comparable basis with the U.S. data employed in this study.

1/ Donald E. Farrar and Robert R. Glauber, "Multicollinearity in Regression Analysis: The Problem Revisited," Review of Economics and Statistics Vol. 49, No. 1 (February 1967), pp. 92-107

Industry	Equation 1				Equation 2			
	Determinant of correlation matrix		Chi Square (degrees of freedom)		Determinant of correlation matrix		Chi Square (degrees of freedom)	
		Variables		F-Statistic		Variables		F-Statistic
2285 Yarn Mills Wool	.515148		13.708219[A] (6)		.901284		2.182641 (3)	
		Pi		3.707 1/		Pi/Pd		.174
		Pd		2.703		ACT		1.042
		ACT		2.369		DSD69		1.015
		DSD69		0.673				
2381 Fabric Dress & Work Gloves	.024588		77.815338[B] (15)		.495283		14.989347 (10)	
		Pi		4.512 2/		Pi/Pd		.754
		Pd		35.037 2/		ACT		.510
		ACT		35.349 2/		Q_2		2.415
		Q_2		1.829		Q_3		2.614
		Q_3		2.095		Q_4		3.233 1/
		Q_4		2.620				
2432 Veneer & Plywood	.37477		25.517517[B] (3)		.735261		8.098279[B] (1)	
		Pi		8.382 2/		Pi/Pd		9.362 2/
		Pd		9.666 2/		ACT		9.362 2/
		ACT		10.492 2/				
2824 Synthetic Organic Fibers	.03303		70.4823[B] (6)		.2542		28.7642[B] (3)	
		Pi		49.331 2/		Pi/Pd		28.566 2/
		Pd		18.587 2/		ACT		28.565 2/
		ACT		44.004 2/		DSD69		.217
		DSD69		.1413				
3021 Rubber Footwear	.037761		85.188110[B] (3)		.339794		28.424576 (1)	
		Pi		25.544 2/		Pi/Pd		50.517 2/
		Pd		133.836 2/		ACT		50.517 2/
		ACT		97.609 2/				
3111 Leather	.033636		73.4967[B] (6)		.9142826		1.95846 (3)	
		Pi		98.793 2/	Note Δ in Pi/Pd	Pi/Pd		.128154
		Pd		97.476 2/		ACT		.932775
		ACT		6.046 2/		DSD71		.921520
		DSD71		.726				
3141 Footwear	.010526		100.186600[B] (3)		.990443		.214477 (1)	
		Pi		58.377 2/		Pi/Pd		.212
		Pd		154.504 2/		ACT		.212
		ACT		158.487 2/				
3151 Leather Gloves	.017044		52.935425[B] (15)		.188682		22.2359[A] (10)	
		Pi		15.259 2/		Pi/Pd		1.967
		Pd		16.668 2/		ACT		5.677 2/
		ACT		5.536 1/		Q_2		2.323
		Q_2		1.706		Q_3		4.848 1/
		Q_3		3.547 1/		Q_4		5.393 1/
		Q_4		3.932 1/				
3161 Luggage	.014633		76.040848[B] (3)		.549884		10.964203[B] (1)	
		Pi		85.984 2/		Pi/Pd		14.734 2/
		Pd		129.605 2/		ACT		14.734 2/
		ACT		43.758 2/				
3262 &3263 China	.013111		111.246857[B] (6)		.522975		16.85376[B] (3)	
		Pi		34.262 2/		Pi/Pd		10.52 2/
		Pd		119.94 2/		ACT		8.838 2/
		ACT		196.321 2/		DSD71		1.511
		DSD71		1.026				
3269 Pottery Products N.E.C.	.173787		32.082001[B] (1)					
		Pi		85.575 2/				
		ACT		85.575 2/				
3421 Cutlery	.030055		89.954346[B] (6)		.337236		28.261276[B] (3)	
		Pi		50.028 2/		Pi/Pd		23.199 2/
		Pd		44.017 2/		ACT		22.017 2/
		ACT		36.220 2/		DSD71		.935
		DSD71		.706				
3572 Typewriters	.178524		51.690872[B] (3)		.972696		.839738 (1)	
		Pi		1.762		Pi/Pd		.842
		Pd		62.833 2/		ACT		.842
		ACT		59.13 2/				

Table 6 TESTS FOR MULTICOLLINEARITY--cont.

Industry	Equation 1				Equation 2			
	Determinant of correlation matrix	Variables	Chi Square (degrees of freedom)	F-Statistic	Determinant of correlation matrix	Variables	Chi Square (degrees of freedom)	F-Statistic
3711 Passenger Cars	.038805		71.4823[B] (3)		.397088		20.525484[B] (1)	
		Pi		59.154 2/		Pi/Pd		33.403 2/
		Pd		47.738 2/		ACT		33.403 2/
		ACT		44.681 2/				
3871 Watches & Clocks	.033537		84.877518[B] (15)		.460378		19.651278[A] (10)	
		Pi		16.287 2/		Pi/Pd		1.447
		Pd		20.359 2/		ACT		1.408
		ACT		31.093 2/		Q_2		2.990 1/
		Q_2		2.288		Q_3		3.071 1/
		Q_3		2.355		Q_4		3.09 1/
		Q_4		2.562				
3914 Silverware, Plateware, & Stainless Steel	.017573		105.075782[B] (3)		.999990		.000253 (1)	
		Pi		111.913 2/		Pi/Pd		.00025
		Pd		112.664 2/		ACT		.00022
		ACT		340.584 2/				
3941 Toys & Gemes	.035119		70.329132[B] (15)		.555610		12.537346 (10)	
		Pi		5.778 2/		Pi/Pd		.152
		Pd		19.281 2/		ACT		.190
		ACT		22.523 2/		Q_2		2.429
		Q_2		1.857		Q_3		2.320
		Q_3		1.946		Q_4		2.683
		Q_4		2.080				
3942 Dolls	.203721		39.775131[B] (15)		.5175		16.588232 (10)	
		Pi		6.754 2/		Pi/Pd		.652
		Pd		2.124		ACT		.691
		ACT		3.932 2/		Q_2		2.915 1/
		Q_2		2.237		Q_3		3.002 1/
		Q_3		2.303		Q_4		3.184 1/
		Q_4		2.482				
3949 Sporting & Athletic Goods N.E.C.	.128012		53.446411[B] (3)		.777303		6.63403[A] (1)	
		Pi		25.320 2/		Pi/Pd		7.449 1/
		Pd		19.775 2/		ACT		7.449 1/
		ACT		45.426 2/				
3963 Buttons	.261772		34.847260[B] (3)		.367839		26.336243[B] (1)	
		Pi		4.790 1/		Pi/Pd		44.683 2/
		Pd		30.381 2/		ACT		44.683 2/
		ACT		22.985 2/				

Chi-square interpretation:
unmarked - Coefficient of determination significantly different from 0 at 95% level of significance, implies little multicollinearity among independent variables.
A -Coefficient of determination significantly different from 0 at 95% to 99% level of significance, implies moderate degree of multicollinearity.
B. -Coefficient of determination significantly different from 0 at 99% level, implies high degree of multicollinearity.

F-Statistic interpretation: Used to explain each explanatory variable's dependence on other members of the set.
unmarked - Not significantly different from 0 at the 95% level of significance.
1/ -Significant at the 95% level of significance.
2/ -Significant at the 99% level of significance.

With respect to the comparability question, the problem of matching the U.S. import and wholesale price series with export price indexes of other countries is handled principally by description. For the industries reported here, foreign export price series exist for at least one major trading country. However, many four-digit SIC industries in the U.S. do not have comparable foreign categories--either due to the data not being collected or reported or because they are much too aggregated to be comparable with the U.S. data. Hence the industry coverage in this study is limited by data availability.

In general, the elasticity calculations in this paper show considerable improvement over earlier estimates of disaggregated import demand functions. Furthermore, they provide a useful guideline for comparing the relative price and the "income" elasticities of various industries. This information provides a basis for making inter-industry comparisons of the effects on imports of decisions bearing on import (and domestic) prices. It is hoped that the list of import categories will be extended in future research to obtain more complete coverage.