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PRICE COMPETITIVENESS IN EXPORT TRADE AMONG INDUSTRIAL COUNTRIES

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Price Competitiveness in Export Trade Among Industrial Countries*[1/]

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More than three years have passed since the revaluation of the German mark initiated a period of greater flexibility in exchange rates, and about one year since a new rate structure was agreed at the Smithsonian conference. Academic researchers and government officials everywhere are scrutinizing current trade data for signs indicating the effectiveness of the realignment, particularly any solid start toward reversals in the deficit of the United States or the surpluses of Japan, Germany, and Canada. The magnitude of the prospective total effect had been assessed largely on the assumption, unconfirmed by empirical work, that the response of trade flows to changes in the exchange rate would resemble that to changes in foreign trade prices in general; and the timing of the effect was almost pure guesswork.

It need hardly be emphasized that the questions of the magnitude and the timepath of the response of trade flows to the realignment

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have come to be of eminent practical importance. Should the absence of a large equilibrating effect of recent changes in exchange rates on trade flows during 1972 be taken as an indication that the realignment was insufficient or merely that most of its effect is yet to come? Will 90 per cent of the total realignment effect have worked through by the second half of 1973, as is often alleged, or only by 1975 or even later?

In the present paper we try to contribute to the discussion of these topics by providing some empirical estimates of the time dimension of responses of export flows of manufactured goods among industrial countries to changes in relative prices and by testing whether these responses are significantly different if changes in relative prices are brought about by alterations in exchange rates or by changes in export prices measured in national currencies. We do not, however, attempt a full analysis of what is generally called "competitiveness." Variation of relative prices is only one of the determinants of export market shares--the basic element in our analysis--and, furthermore, changes in these shares cannot, by themselves, serve as an adequate indicator of a country's external competitiveness.

As to the timing of trade effects, collective wisdom, based mainly on intuition rather than empirical study, put the time it would take for most of the effects of the Smithsonian realignment to work through at somewhere between eighteen months and two years. However, there are reasons why one might expect the adjustment to take longer

than that. This becomes clear when the overall delay in the response is decomposed into various elements. First, there is a recognition lag: it takes time for buyers and sellers to become aware of the changed competitive situation, and this delay may be rather longer in international than in domestic trade because of language and distance obstacles to the spreading of information. Second, there is a decision lag: it takes time for new business connections to be formed and new orders to be placed. Third, there is a delivery lag: even if import orders are placed soon after the change in relative prices has occurred, published trade flows--and, ordinarily, payments--will respond only when the goods are delivered; this may vary from a few months after orders are placed, e.g., for certain consumer goods, to a few years for electrical generating equipment. Fourth, there may be a replacement lag: in some instances, inventories of materials must be used up or equipment allowed to wear out before any new materials or equipment can be bought. Fifth, there is a production lag: producers have to become convinced that a profit opportunity which they perceive in certain markets is sufficiently large and permanent to warrant the expense and effort of shifting from supplying one market to supplying another or of adding capacity in order to supply the additional market; the extreme case in this category would be a supplier deciding to manufacture a new product line or reactivate an abandoned line because of new market opportunities created by price and cost changes.

Reflection on these various lags makes it plausible to think of the overall lag of trade flows behind price changes to be properly measured in terms of years rather than quarters. In fact, in an earlier study[2/] we found that longer-run elasticities of substitution were higher than short-run ones and that the explanatory power of the price variable also rose when longer unit periods of observation were used. In part, this might be so because a certain amount of random variation disappears when data are averaged over longer periods, but these results also indicate that exploration of longer time lags might be fruitful.

As to the response to exchange rate changes compared with that to other relative cost changes, the generally larger size of par value changes and the publicity that attaches to them argues for a more immediate response than that to price changes in general. On the other hand, if par value changes are undertaken--as they have tended to be--to correct large disequilibria which have cumulated over some period of time, relatively large resource shifts with a correspondingly long response time may be required. These two factors could well offset each other, so that reactions to exchange rate changes might appear neither faster and stronger nor slower and feebler than reactions to price changes measured in national currencies. Although this need not be true in the short run, the homogeneity assumptions made in economic theory argue that the long-run response to par-value changes, other

2/ H. B. Junz and R. R. Rhomberg, "Prices and Export Performance of Industrial Countries, 1953-63," IMF Staff Papers, July 1965, 12, 224-271.

things being equal, should not differ from that to relative price changes in general.

Approach. In order to explore the two questions raised--that of the timing of the effects of relative price changes on export flows and that of any differential response to different types of price changes--two kinds of calculation were performed. In the first, proportionate changes in market shares were related to proportionate changes in relative export prices. This yields a price elasticity of market shares, a concept that is akin to, though not identical with, the elasticity of substitution. In the second calculation, proportionate deviations of exports from a standard set by previously attained market shares are related to proportionate changes in export prices. This furnishes a price elasticity of exports at a given size of export markets. Such an elasticity should be expected to be somewhat lower than the true partial price elasticity of exports since it leaves out of account any effect of a change in the price of exports on countries' imports, that is, on the size of export markets available to all exporting countries together.

Both calculations take the level of demand for exports from all supplying countries as given and concentrate on the role played by export prices in determining its division among competing exporter countries. The effects of changes in economic activity, domestic prices, inventories, and a number of other factors affecting the demand for imports need not be taken into account separately since they are implicit

in the measure of market size. However, this procedure cannot eliminate the effects that variation in income may have on the commodity composition of demand. To the extent that a market comprises goods with markedly different income elasticities of demand, changes in economic activity may well influence the market shares of supplying countries producing different goods. In order to minimize these possible distorting effects, some of the share calculations reported below use data for 18 separate commodity groups. In a further attempt to reduce the effects of both cyclical and random fluctuations, all calculations were repeated with the dependent and independent variables averaged over longer periods of time, namely, over periods of two, three, or four years in length.

The number of annual observations available is small for calculation of the two types of elasticity from time series alone, especially when it is intended to test for lags of several years in the response of export performance behind price changes. By postulating that the relevant elasticities are constant as between markets or exporting countries, or both, as well as over time, calculations utilizing observations pertaining to all exporters, markets, and years can usefully be made.3/

3/ The data, taken from publications by the Organization of Economic Cooperation and Development (OECD) and the United Nations (UN) and from OECD trade data tapes, comprise annual exports of manufactures of 13 industrial countries to 14 industrial markets for the period 1953-69. The 13 exporting countries are Austria, Belgium-Luxembourg, Canada, Denmark, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom, and the United States. Switzerland could not be included because data are incomplete, but it is used as an additional market for the exports of the 13 exporting countries included in the study. Exports of manufactured goods are defined to include Standard Industrial Classification (SITC) sections 5-8 of the revised United Nations Code.

Comparison of results obtained with subsets of this sample can give some indication about the degree to which the postulate of uniformly constant elasticities is justified. This postulate is supported by the finding in our earlier study that the elasticities do not seem to vary by size of market share, although this test was not repeated with the present data.

Since true price indices for manufactured exports are not available for most countries, unit value indices were used as the explanatory price variable. In view of their well-known shortcomings, some of the calculations were repeated with "export-weighted wholesale prices", for which components of wholesale price indices were recombined with weights corresponding to the shares of various commodity groups in the total trade of the industrial countries. The purpose here was to test, first, whether these price indicators are more satisfactory than unit value indices and, second, whether they performed at least sufficiently well to justify their use in connection with export data disaggregated by commodity, for which unit values are not generally available.

To measure the changes in relative prices of exports in a particular market, each country's price index (be it unit value or export-weighted wholesale price) was divided by the weighted average of the price indices of all exporters, with their shares in that market in the preceding year taken as weights. There may be considerable variation in this index for any particular country across markets if that country faces different competitors in different markets and if price movements diverge among suppliers.

A better approximation of changes in dollar unit values to actual price changes was sought by adjusting the unit value index for the deviation of the spot exchange rate from the par value. This was done on the assumption that for statistical purposes most trade values are converted into dollars at par and that, therefore, price variations arising from fluctuations of the exchange rate around par are not reflected in the published unit value indices. Lack of data precluded a corresponding adjustment for the cost of forward cover. Tests with adjusted and unadjusted indices suggested the use of the former.

In our previous study, export values were deflated by unit value indices and the resulting export volume data used in most computations. The present study, by contrast, uses mostly the original export value data. Market shares are therefore measured in value terms, except where noted otherwise. It should be remembered that elasticities of value shares with respect to concurrent price changes are algebraically greater by unity than the corresponding elasticities of volume shares. However, value and volume elasticities with respect to lagged price changes do not differ.

Results. Selected results of the calculations yielding price elasticities of market shares are shown in Table 1. Lags of changes in market shares behind changes in prices of up to five years were explored. When annual periods are used, the total number of percentage changes in market shares is 1859--corresponding to 11 percentage changes for 1958-69

(allowing for 5 lags in price data going back to 1953) for 13 exporting countries in 13 markets. In six simple regression equations under A of Table 1, percentage changes in market shares are related, alternatively, to concurrent and lagged percentage changes in relative prices. All regression coefficients are statistically significant at the 95 per cent confidence level, but the proportion of statistical explanation achieved, as measured by the coefficients of determination, is very low. Changes in value shares seem to be related more closely to price changes three years earlier than to those occurring at any other time.

Since it is less important to choose a single optimal time lag than to obtain a notion of the whole time profile of the expected adjustment, price elasticities of market shares were estimated simultaneously for all lags from zero to five years (B of Table 1). Three of the six elasticities are statistically significant, those corresponding to the unlagged price and to lags of two and three years. Here, too, the level of explanation of changes in market shares is very low, 2.2 per cent. However, the lag pattern seems plausible: from a concurrent value elasticity of -0.5 the response declines at first, but it rises again to a peak of -1.0 in the third year before falling off for the longer lags. One should expect some immediate response to a relative price change, particularly as measured in unit values (which represent delivery rather than contract prices) for items that are produced quickly and are relatively homogeneous across suppliers. For many other goods

Table 1. Average "Price" Elasticities of Market Shares in Manufactured Exports of Thirteen Industrial Countries[1/]

		Lag of Market Shares Behind "Price" Variable, in Years					
		0	1	2	3	4	5
Annual percentage changes (1859 observations)							
A. Six simple regressions with indicated lags	Unit-value elasticity	-.75	-.55	-.83	-1.21	-.52	-.46
	t ratio	(3.3)	(2.4)	(3.5)	(5.4)	(2.3)	(2.1)
	$\bar{R}^2$	.005	.003	.006	.015	.002	.002
B. One multiple regression with all lagged unit-value terms included[2/]	Unit-value elasticity	-.52	-.29	-.58	-.98	-.24	-.27
	t ratio	(2.2)	(1.2)	(2.4)	(4.2)	(1.0)	(1.2)
Three-year percentage changes (507 observations)							
C. Six simple regressions with indicated lags	Unit-value elasticity	-1.10	-1.42	-1.59	-1.78	-1.81	-1.58
	t ratio	(3.8)	(5.0)	(6.1)	(7.0)	(7.3)	(6.9)
	$\bar{R}^2$	.026	.045	.067	.087	.095	.084
D. Six multiple regressions with unit values split into exchange-rate and local-currency components; indicated lags	Exchange-rate elasticity	+.14	-.86	-1.43	-1.70	-1.71	-1.35
	t ratio	(0.3)	(1.9)	(4.1)	(5.0)	(4.8)	(4.1)
	Local-price elasticity[3/]	-1.47	-1.48	-1.73	-1.90	-1.87	-1.70
	t ratio	(4.8)	(5.2)	(6.3)	(7.1)	(7.4)	(7.2)
	$\bar{R}^2$	.048	.048	.070	.090	.095	.098

1/ All industrial countries other than Switzerland. Shares in 14 industrial markets (including Switzerland) are calculated for the 12 years, and the 4 three-year periods, 1958-69; there are thus 11 annual and 3 three-year percentage changes in 13 market shares for each of the 13 exporting countries. The price variable is based on export unit values.

2/ The constant term is 0.019 with a t ratio of 3.2; $\bar{R}^2$ is 0.022. The sum of the six elasticities, -2.88, indicates the long-run elasticity of market shares in value terms with respect to changes in unit values. The corresponding elasticity of market shares in volume terms would be -3.88.

3/ The local-currency price index is calculated by dividing the unit-value index by the exchange rate index.

one would expect lags of more than one year in the adjustment of buyers and suppliers to the changed price situation. The effect over the long run of price changes on value market shares is measured by the sum of the estimated yearly elasticities, -2.88. The long-run elasticity of market shares defined in volume terms is, therefore, -3.88.

The fact that the explanatory power of the price variable is rather low does not detract from the results to any appreciable extent. Although random fluctuations in the annual changes apparently swamp the systematic relationship being explored, the latter is nevertheless statistically significant. Moreover, a large number of pooled observations in the form of percentage changes would tend to yield a low $\bar{R}^2$. For both these reasons the extent to which price changes explain changes in market shares is increased when longer unit periods are chosen. Under C the equations shown under A are repeated with three-year averages (507 observations). The coefficient of determination is highest when market shares are lagged behind prices by three to five years, with a peak for the four-year lag. In this case almost 10 per cent of the variation in market shares is explained by relative price movements. The estimated price elasticity for either a three-year or four-year lag is about -1.8.

Under D, these calculations are repeated with the price variable split into two parts: the relative exchange rate and the relative variation in prices measured in national currencies. At

least for the three and four-year lags, the response to price changes seems to have been the same however these changes came about. The national currency price elasticity is statistically significant throughout. The relative exchange rate variable becomes significant only when lagged by two years or more. This pattern, confirmed by other calculations not shown in the table, may reflect the fact, discussed above, that the explanatory price variable represents delivery rather than contract prices. This is particularly important for par-value changes, when splitting unit values into local-currency and exchange-rate changes tends to give too much weight to the exchange rate component in the concurrent year.

In the second type of calculation, the variable to be explained by relative price changes is the deviation of a country's exports from what it would have achieved if its shares in all markets had remained constant from the preceding unit period to the current one. The data are pooled over all exporting countries and time periods, so that 65 observations are available when a two-year unit period is used and 26 observations when a four-year unit period is used. Market shares are assumed to be constant alternatively in value terms and in volume terms. For the value equations, deviations of exports from the constant share assumption are calculated for each of 18 commodity groups and these excesses and shortfalls are then summed. For the volume equations, disaggregation by commodity group was not

possible since unit values are available only for total exports of manufactured goods. Tests using export-weighted wholesale prices for this purpose still need to be made.

In these calculations, prices explain deviations of exports from constant market shares to a rather high degree, 20 per cent for the two-year averages and around 40 per cent for the calculations with four-year averages (Table 2). The implied price elasticity of exports (in value terms) lies mostly between -1 and -1.5 and between -2 and -3, for the respective sets of estimates.

These results, also, do not show as clear an indication of the time profile as was obtained in the year-to-year calculations. When two-year averages are used, a lag of four years appears best, but only marginally better than a two-year lag. With four-year averages, the various lags are even less distinguishable. These results nevertheless confirm the hypothesis that the lag structure attaching to the response of trade flows to relative price changes is rather longer than the 18 months often postulated. By averaging prices over longer time periods, a certain average lag is already built into the relation. Price changes at the beginning of any unit period will affect share changes at the end of it, so that even the concurrent price variable implies an average lag of half a unit period. Therefore, the lag structure deriving from these equations is not really comparable with that reported for year-to-year changes. It clearly would be useful to repeat these particular equations with the same dependent variables but with

Table 2. Average "Price" Elasticities of Manufactured Exports of Thirteen Industrial Countries[1/]

		Lag of Exports Behind "Price" Variable, in Years					
		0	1	2	3	4	5
Two-year averages (65 observations)							
Value of exports[2/]	Unit-value elasticity	-.75	-.90	-1.43	-1.16	-1.41	-.98
	t ratio	(2.0)	(2.9)	(4.4)	(3.9)	(5.0)	(3.6)
	$\bar{R}^2$	.045	.106	.226	.185	.272	.160
Volume of exports[3/]	Unit-value elasticity	-1.93	-1.70	-1.85	-1.26	-1.74	-1.36
	t ratio	(4.6)	(4.8)	(4.6)	(3.3)	(4.8)	(4.0)
	$\bar{R}^2$	.237	.256	.236	.133	.259	.193
Four-year averages (26 observations)							
Value of exports[2/]	Unit-value elasticity	-2.84	-2.79	-2.53	-1.97	-2.26	-2.24
	t ratio	(3.7)	(4.6)	(4.5)	(3.8)	(4.4)	(4.2)
	$\bar{R}^2$	.337	.444	.431	.353	.418	.394
Volume of exports[3/]	Unit-value elasticity	-4.26	-3.75	-3.07	-2.33	-2.64	-2.70
	t ratio	(4.4)	(4.5)	(3.7)	(3.1)	(3.4)	(3.4)
	$\bar{R}^2$	.420	.433	.335	.256	.298	.302

1/ The dependent variable is the percentage deviation of actual exports from those that would have been achieved if market shares had been maintained at the average of the two or four preceding years, respectively. The independent variable is the percentage change in relative unit values either unlagged or, alternatively, lagged by 1. 2, ..., 5 years.

2/ Constant shares exports in value terms are calculated by 18 commodity groups and then aggregated.

3/ The volume of exports is derived from value figures by deflating them with the unit-value index. Constant shares exports in volume terms are calculated for manufactures taken as a single commodity.

concurrent and lagged price variables for single years as independent variables so as to obtain further confirmation of the time profile found in the single year equations.

The calculations made in volume terms generally confirm those in value terms. However, there is some reason to put somewhat more reliance on the computations in value terms because in these equations it was possible to abstract to some degree from short-term changes in the structure of demand--that is, changes associated with fluctuations in economic activity--by stipulating that market shares be constant not only for manufactured exports in the aggregate but also for each of 18 different commodity groups.

Results obtained for the calculations with export-weighted wholesale prices are not shown separately. They tended to confirm those derived from unit values and, from a statistical point of view, were not more conclusive than those discussed above. Therefore, the wholesale price proxy for export price movements is not likely to be a generally better indicator than that derived from unit values. However, results were much better than those obtained in the earlier study with raw wholesale price indices. In fact, they were sufficiently satisfactory to warrant the use of export-weighted wholesale prices in statistical experiments with disaggregated commodity groups.

Conclusions. The response of trade flows to relative price changes quite clearly seems to stretch out over a rather longer period

than has generally been assumed, perhaps around four to five years. Almost 50 per cent of the full effect appears to work through during the first three years, and about 90 per cent during the first five years, following a price change.

Separation of the exchange rate change component from the price change in local currency shows in general that, after an initial "perverse" effect, the response to exchange rate changes is very similar to the response to price changes measured in local currency.

Of course, there is considerable uncertainty as to how these results might apply to a particular country or in particular circumstances. Still, they indicate that a large part of the response of export flows of manufactured goods to the exchange rate changes of 1969-1971 may occur only in 1974 and later, and 90 per cent of the full effect may not be realized before 1976.