Note on the Measurement of Elasticity of Substitution in International Trade: A Reply

J. Tinbergen

small absolute deviations in the differences on which the elasticities are computed may affect the bias in a very pronounced way.

The preceding derivation of biases explains why, on the basis of the same material, Tinbergen found elasticities of substitution ranging around -2, with figures for some countries considerably higher in absolute amount, while all but four of the elasticities found by Chang were between o and -1, and the weighted average of all his elasticities was $-.56$.[8]

ANNEX

The quasi-elasticity H' is defined as the ratio between the observed percentage change in the quantity ratio $\left(\dfrac{x_1}{x_2}\right)$ and the observed price ratio $\left(\dfrac{p_1}{p_2}\right)$:

$$\left(\frac{x_1}{x_2}\right) = \left(\frac{p_1}{p_2}\right)^{H'} \qquad (9)$$

or

$$H' = \frac{\log x_1 - \log x_2}{\log p_1 - \log p_2} \qquad (10)$$

It is derived as follows. Write (2), (3), (4), and (5) in terms of logarithms:

$$\log x_1 = \eta_1 \log y_w + \sigma_1 \log p_1 - \sigma_1 \log p_2 \qquad (11)$$

$$\log x_2 = \eta_2 \log y_w + \sigma_2 \log p_2 - \sigma_2 \log p_1 \qquad (12)$$

[8] Some very recent studies (as yet unpublished) would make it probable that Chang's findings cannot be taken as highly reliable estimates of the elasticity of substitution in international trade, and may be biased in the direction of zero owing to (a) high intercorrelation in the material and

$$\log x_1 = \epsilon_1 \log p_1 \qquad (13)$$

$$\log x_2 = \epsilon_2 \log p_2 \qquad (14)$$

Combination of (9) and (11) and (10) and (12) yields two equations with $\log p_1$ and $\log p_2$ as unknowns:

$$\epsilon_1 \log p_1 = \eta_1 \log y_w + \sigma_1 \log p_1 - \sigma_1 \log p_2 \qquad (15)$$

$$\epsilon_2 \log p_2 = \eta_2 \log y_w + \sigma_2 \log p_2 - \sigma_2 \log p_1 \qquad (16)$$

Solving (15) and (16) for $\log p_1$ and $\log p_2$ we find:

$$\log p_1 = \frac{\eta_1 \epsilon_2 - (\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\epsilon_1 \epsilon_2 - (\epsilon_1 \sigma_2 + \epsilon_2 \sigma_1)} \log y_w \qquad (17)$$

$$\log p_2 = \frac{\eta_2 \epsilon_1 - (\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\epsilon_1 \epsilon_2 - (\epsilon_1 \sigma_2 + \epsilon_2 \sigma_1)} \log y_w \qquad (18)$$

From (13) and (17) and (14) and (18) we find:

$$\log x_1 = \frac{\epsilon_1 \epsilon_2 \eta_1 - \epsilon_1(\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\epsilon_1 \epsilon_2 - (\epsilon_1 \sigma_2 + \epsilon_2 \sigma_1)} \log y_w \qquad (19)$$

$$\log x_2 = \frac{\epsilon_1 \epsilon_2 \eta_2 - \epsilon_2(\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\epsilon_1 \epsilon_2 - (\epsilon_1 \sigma_2 + \epsilon_2 \sigma_1)} \log y_w \qquad (20)$$

Hence, from (17), (18), (19) and (20):

$$H' = \frac{\epsilon_1 \epsilon_2 (\eta_1 - \eta_2) + (\epsilon_2 - \epsilon_1)(\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\eta_1 \epsilon_2 - \eta_2 \epsilon_1} \qquad (21)$$

This may also be written as:

$$H' = \frac{\epsilon_1 \epsilon_2 (\eta_1 - \eta_2) + (\epsilon_2 - \epsilon_1)(\eta_1 \sigma_2 + \eta_2 \sigma_1)}{\epsilon_1 (\eta_1 - \eta_2) + (\epsilon_2 - \epsilon_1)\eta_1} \qquad (21')$$

(b) use of unsatisfactory index numbers. This question is, however, separate from the discrepancy between Tinbergen's and Chang's findings based on the same material and, with the one exception noted, on the same method.

A REPLY

J. Tinbergen

In the article under discussion I expressed the wish that the field of elasticities of substitution would be explored more intensively. I very much welcome Dr. Polak's contribution.

In my previous publications [1] the restricted

[1] Cf., e.g., *The Influence of Prices on Exports* (De Nederlandse Conjunctuur, Special Memoranda, Nr. 1, p. 6).

value of my procedure was indicated, and I admit that the danger on which Dr. Polak focuses attention is in many cases a great danger, indeed, which I have underestimated. His argument, however, is based on the assumption that there is a complete correlation between prices and incomes. It does not apply,

therefore, to price movements which are due to (a) sudden currency devaluations or appreciations and (b) crop movements.

At least for some countries, dealt with in my article, crop movements seem to have been the most important prime movers of prices, viz., in the case of the Argentine and in the case of Hungary. It would seem to me, therefore, that the results for these countries are not subject to such large biases as Dr. Polak's remarks suggest.

Moreover, I am not quite in agreement with his second point, viz., that there would be zero substitution between manufactured goods and raw materials or between manufactured goods and foodstuffs. In a sense, there is always competition for income; in addition, raw cotton may compete with cotton yarns for the buying power of the textile industry. Finally, almost every pair of countries is competing at least in some markets.

The main argument of this part of Dr. Polak's criticism is directed against the use of macroeconomic, i.e. aggregative, concepts. The validity of this argument must be accepted in principle. Different problems require different methods of aggregation and, where possible, we should endeavor to find the method appropriate to each problem. It may be that in order to indicate the effects of devaluation we have to operate with a different aggregate of elasticities of individual exports than when we study the effects of fluctuations in the crops of these same export commodities.

Nevertheless, I fully admit that Dr. Chang's and Dr. Polak's approximations deserve more confidence than my rough first attempts. Their conclusions are the more interesting since they reinforce my own first impression that the elasticities are so low as to make it possible for the balance of payments mechanism not to function in the classical way.

DEVALUATION WITH IMPERFECT MARKETS AND ECONOMIC CONTROLS

Arthur Smithies

WITH the devaluation of sterling and most European currencies, at least one phase of the debate about exchange rate adjustments has been settled in a practical way. The countries have realized that without devaluation they could not hope to achieve the level of exports needed to satisfy their import demands. But there is still widespread debate about the positive effects of devaluation — a debate that will be settled only by events and that cannot be settled satisfactorily by statistics or speculation.

In this note I wish to call attention to some aspects of the matter that make devaluation appear in a more promising light than it frequently does in public and professional discussion. The traditional assumption is that the supply price of exports is determined by cost conditions in the exporting country. With the 30 per cent devaluation of sterling, this would mean that the United States prices of

sterling products would initially be reduced by 30 per cent less allowance for dollar raw materials. In that event, a very large increase in sterling exports would be required even to keep dollar earnings at their pre-devaluation level. But that general appraisal of the situation ignores the possibility of physical limitations on the supply of exports, and the possibility of private or government controls over the price or quantity of exports.

American hopes of cheaper Scotch whisky have already been dashed because at present the supply is inelastic, and British exporters have therefore announced that there will be no reduction in price. Thus for the time being an inelastic supply will insure Britain against any loss of dollar earnings from whisky exports, but it will also preclude the possibility of gain.

Devaluation will greatly increase the profits in terms of sterling from exports to the dollar