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EXPORT DEMAND ELASTICITIES WITH LESS THAN PERFECT MARKETS

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Quantification of the elasticity of export demand for a given commodity from a single country is of importance in analysis of commodity trade policies and in the construction of a general equilibrium model for the exporting country. The art of deriving estimates of the export demand elasticity from empirical estimates of consumption demand elasticities and production supply elasticities has been obscured by some theoretical confusion.

This confusion might arise from the excessive attention (e.g. Butler and Saad 1974) given to the special case of

$$\eta_{xa} = \eta(C/X_a), \tag{1}$$

where η_{xa} is the export demand elasticity facing country a for a particular commodity,

η is the consumption demand elasticity in the rest of the world, and

X_a/C is the share of the world market held by exports from country a.

The preceding result is conditional on there being:

(a) no supply response from competing producer countries;

(b) no product differentiation, so that exports from a are perfect physical substitutes for all versions of the commodity from all sources;

(c) no intervention by governments of exporting or importing countries, so that the commodity is cleared on a single free international market.

Some authors have attempted to generalise equation (1), but have failed to eliminate all three of these restrictions (e.g. Horner 1952; Taplin 1971). A general expression for the elasticity of export demand was in fact provided by Tweeten (1967). However, confusion was still rife when Paul Johnson (1977) adversely criticised the Tweeten solution. Given this background, it seems desirable to derive the general expression with unambiguous clarity. The following algebra relates to a single commodity and subscripts indicate country.

The quantity demanded (X_a) of one country's exports of a commodity is identically equal to the sum of the quantities demanded (C_i) in every other country less the sum of the quantities supplied (S_j) in every other country:

$$X_a \equiv \Sigma_i C_i - \Sigma_j S_j, \quad i, j \neq a. \tag{2}$$

Differentiating with respect to the single country's export prices (P_a),

$$\partial X_a/\partial P_a = \Sigma_i \, (\partial C_i/\partial P_a) - \Sigma_j \, (\partial S_j/\partial P_a). \tag{3}$$

By definition the elasticity of export demand,

$$(4) \qquad \eta_{xa} = (\partial X_a/\partial P_a)\ (P_a/X_a)$$
$$= \Sigma_i\ (\partial C_i/\partial P_a)\ P_a/X_a - \Sigma_j\ (\partial S_j/\partial P_a)\ P_a/X_a$$
$$= \sum_i \frac{\partial C_i}{\partial P_i} \cdot \frac{P_i}{C_i} \cdot \frac{\partial P_i}{\partial P_a} \cdot \frac{P_a}{P_i} \cdot \frac{C_i}{X_a} - \sum_j \frac{\partial S_j}{\partial P_j} \cdot \frac{P_j}{S_j} \cdot \frac{\partial P_j}{\partial P_a} \cdot \frac{P_a}{P_j} \cdot \frac{S_j}{X_a}$$

where P_i is the consumer price in country i and P_j is the producer price in country j. Thus

$$(5) \qquad \eta_{xa} = \sum_i \eta_{ii}\ \phi_{ia}\ C_i/X_a - \sum_j \varepsilon_{jj}\ \theta_{ja}\ S_j/X_a$$

where η_{ii} is the own-price elasticity of demand in country i,
ε_{jj} is the own-price elasticity of supply in country j,
ϕ_{ia} is the elasticity of the consumer price in i to the export price in a,
θ_{ja} is the elasticity of the producer price in j to the export price in a.

The preceding expression can be applied at whatever level of aggregation is appropriate. Subscripts i and j could be used to indicate disaggregation not only among countries but, if relevant, among regions, user industries, market segments, etc.

In the case of a perfectly homogeneous commodity sold in a free international market (all $\phi_{ia} = 1$) and with inelastic alternative supplies (all $\varepsilon_{jj} = 0$), equation (5) reduces to equation (1):

$$\eta_{xa} = \Sigma_i \eta_{ii}\ C_i/X_a = \eta(C/X_a).$$

The terms ϕ_{ia} and θ_{ja} in equation (5) are warning signs that should alert one to the dangers in making glib assumptions about free and perfect markets and homogeneous commodities.

Some Illustrations

(a) Retail margins. If the values used for the η_{ii} were estimated with respect to retail price data, then the ϕ_{ia} should take account of the gearing between retail and commodity market prices. For example, if margins represent about 50 per cent of the price at retail (and are independent of the buying-in price) then $\phi_{ia} \doteq 0{\cdot}5$.

(b) Heterogeneous commodities. For example, in a calculation of the export demand elasticity for Australian wool one should take account of (*inter alia*) the weak substitution between (finer) Australian wools and (coarser) New Zealand (NZ) wools, i.e. the elasticity of NZ to Australian wool prices, $\theta_{nz \cdot a} < < 1$.

(c) Market imperfections. International commodity statistics frequently include significant quantities imputed to subsistence outputs in developing countries. Since arbitrage between, say, the market for internationally traded beef and nomadic cattle herding in the Ethiopian highlands is likely to be extremely weak, one should treat the relevant price-on-price elasticity (θ_{ia}) as approximately zero.

(d) Deficiency payments. National agricultural policies frequently seek to achieve production (or farm income) targets for a commodity. If the instruments used are deficiency payments (or the price guarantees of the former UK farm policy), then the nexus between that country's farmgate price and the international commodity market is cut. It would

appear that (except when the guarantee lies below the current world price) $\theta_{ia} \simeq 0$.

(e) Import quotas. More commonly today the major consuming countries seek to pass the costs of agricultural support onto consumers by using import quotas and/or variable import levies. Such instruments tend to insulate local consumer prices as well as local producer prices from the international commodity market. In such cases, as long as the quotas are not under-utilised, it would be right to assume that $\xi_{ia} \simeq 0$ and $\phi_{ia} \simeq 0$.

(f) Exporter cartels. A less common case occurs where exporting countries are organised into a commodity cartel (e.g. petroleum, bauxite). The export demand elasticity facing a third country will be dependent on the cartel's production policy and its effectiveness. The θ_{ja} for cartel members might be very low, presenting the third country with a low export demand elasticity and a degree of monopoly power (see Pindyck 1977).

The Elasticity of Demand for Australian Beef Exports

As a further illustration, it is possible to construct two diametrically opposed estimates of the long-term elasticity of demand for Australian beef exports. Both of these estimates are notional and have no pretence to accuracy. The purpose is to illustrate the importance of making an explicit assessment of the effects of governmental intervention upon the market parameters.

Both calculations assume the same notional data base. World beef consumption has the following (percentage) distribution:

(1) Subsistence economies	10
(2) Communist countries	28
(3) USA, W. Europe, Japan	60
(4) Open markets	2

World beef supply has the (percentage) distribution:

(a) Australian exports	3
(1) Subsistence economies	10
(2) Communist countries	27
(3) USA, W. Europe, Japan	55
(4) Competing exporters (Argentina, Uruguay, New Zealand)	5

It is assumed that all own-price consumption demand elasticities, $\eta_{ii} = -1$; that the export supply elasticity for 'competing exporters', $\varepsilon_{44} = 2$; and that the production supply elasticities for all other countries, $\varepsilon_{jj} = 1$.

The export demand elasticity facing Australia can be defined, using equation (5), as

$$\eta_{xa} = \eta_{11}\,\phi_{1a}\,C_1/X_a + \eta_{22}\,\phi_{2a}\,C_2/X_a + \eta_{33}\,\phi_{3a}\,C_3/X_a + \eta_{44}\,\phi_{4a}\,C_4/X_a - \varepsilon_{11}\,\theta_{1a}\,S_1/X_a - \varepsilon_{22}\,\theta_{2a}\,S_2/X_a - \varepsilon_{33}\,\theta_{3a}\,S_3/X_a - \varepsilon_{44}\,\theta_{4a}\,S_4/X_a.$$

The first calculation predicates that there is a single perfect homogeneous and free world market for beef, so that all ϕ_{ia} and θ_{ja} are equal to unity. Then

$$\hat{\eta}_{xa} = (-1)10/3 + (-1)28/3 + (-1)60/3 + (-1)2/3 - (1)10/3 - (1)27/3 - (1)55/3 - (2)5/3 \simeq -67.$$

The second calculation is based on the opposing assumptions that:

- production and consumption in subsistence economies are not influenced by Australian beef prices, $\phi_{1a} = \theta_{1a} = 0$;
- production and consumption in Communist countries are not influenced by Australian beef prices, $\phi_{2a} = \theta_{2a} = 0$;
- both producer and consumer prices in the USA, W. Europe and Japan are insulated from external price changes by the operation of quotas and/or market intervention with variable import levies, $\phi_{3a} = \theta_{3a} = 0$;
- exports from Argentina, Uruguay and New Zealand are perfect substitutes competing freely with Australian beef, $\phi_{4a} = \theta_{4a} = 1$.

Then, $\hat{\eta}_{xa} = 0 + 0 + 0 + (-1)(1)2/3 - 0 - 0 - 0 - (2)(1)5/3 = -4.$

For most practical purposes the first calculation would be equivalent to employing the 'small country assumption': that a change in the volume exported from Australia will not noticeably change the export price of a commodity. The result of the second calculation is quite inconsistent with that assumption and would support opposing policy conclusions on certain issues. The discrepancy between the two estimates rests on conflicting assessments of the consequences of governmental intervention in market processes.

For several export commodities there may be room for legitimate debate about the consequences of various types of intervention. If assumptions about these consequences were always made explicit, debate would be facilitated and the possibility of slipping into the 'small country assumption' where it is inapplicable would be reduced.

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