Some effort needs to be made to bring applied and theoretical economics closer together. Unfortunately, most of the previous literature on this subject has focused on strategies to eliminate the incentive to mine data. This represents an effort to make the data miner behave like a classical statistician. This is not an appropriate solution to the problem simply because economics are persuaded by a body of evidence, that is, several models which yield the same conclusions. Publishing single results, whether significant or insignificant, is not likely to change anyone's mind about an issue.

The suggestion presented here is just the opposite. Economists should mine data and concisely present the results of their efforts. The computer has made it possible for a single researcher to marshall empirical evidence that only recently would have required the efforts of the entire profession. It only makes sense to take advantage of the increased computer technology.

The problem of inferences on the results of data mining efforts remains, and it is a difficult one to solve. The foundation of the solution to this problem has been set forth by Leamer (1978). Obtaining inferences on mined data is complicated, even for simple data mining schemes. As far as the economics profession is concerned, the problem is complicated by the fact that researchers have no incentive to follow Leamer's suggestions.

Until Leamer's suggestions about inferences on mined data are implemented by the profession, economics should avail themselves of the improved computer technology and mine data. Research papers should include a concise description of the data mining results. The presentation of this body of evidence has more potential to persuade others than a single estimate associated with a large t-ratio. In time, inferences on mined data may become commonplace, but data mining does not have to wait.

REFERENCES


NOTES

1. Throughout this paper, noneconometric economics is the subject of discussion.

2. The dollar amounts have been updated to 1967 dollars.

INTRODUCTION

This paper develops a theoretical condition, which we call the "modified Cournot aggregation condition" that has proved useful in assessing the plausibility of a set of estimates of own and cross-elasticities of demand. It is based on the assumption of "weakly separable" utility or production functions. This assumption is justified in applied work by the fact that when researchers estimate disaggregated demand functions, they invariably exclude from the analysis the prices of goods not closely related to the product of interest. This means that they are either implicitly or explicitly assuming "weak separability." The condition we derive, however, shows that the assumption of weak separability imposes certain restrictions on the values of the cross-elasticities; these restrictions prove useful in assessing estimated elasticities. In particular, we show how this condition has helped avoid perverse results in a three-region model of world steel trade.

Since reliable estimates of cross-elasticities of demand are notoriously difficult to obtain, researchers such as Frisch (1959), Reesling and Parker (1984), Reesling and Suometta (1985, Appendix E), and most notably Armington (1969b) have developed methods of calculating the required elasticities when only limited information is available. As discussed in footnote 10, however, these methods have limitations in certain contexts. Thus, the condition developed in this paper is a useful additional tool for the applied modeler.

The modified Cournot aggregation condition should not substitute for well established statistical methods, such as testing hypotheses regarding the parameters or defining confidence intervals. The condition, however, can complement statistical analysis when the estimates fail to pass statistical tests or if it can be used in the estimation process itself.

In section II, we briefly review the concept of weak separability. In section III, we motivate the derivation of the principle result by starting with an application to estimating the effects of the US and EC extension of the system of voluntary export restraints, where the condition has proved valuable in avoiding perverse results. In section IV, we derive the modified Cournot aggregation condition. An application of the modified Cournot aggregation condition to the CES function is presented in section V.

WEAKLY SEPARABLE UTILITY

A utility function \( u = u(x_1, \ldots, x_n) \) is said to be weakly separable or a "tree" if there exists a partition of the \( n \) products into \( m \) subsets, \( m \) functions \( u_j(x_j) \), and a function \( F \) such that

\[
u(x_1, \ldots, x_n) = F[u_1(x_1), \ldots, u_m(x_m)]
\]

\( \star \) The World Bank, Rm. H-9079, 1818 H Street NW, Washington, DC 20433.

*The author would like to thank John Boszora, Marko Marka, the participants in the workshop on international economic research at the World Bank, an anonymous referee of this journal and especially David Reesling for useful discussions. The views expressed do not necessarily reflect those of the World Bank.
where \( m \geq 2 \) and \( x \) is the vector of the products in the \( r \)-th subset. The \( m \) subsets, which correspond to the product groupings, such as food or clothing, are referred to as branches of the utility tree. It is convenient to utilize double subscripts to denote products. Let \( x_{ij} \) equal the \( j \)-th product in the \( r \)-th branch. Also define \( p_{ij} \) as the price of \( x_{ij} \) as aggregate income available to consumers and \( y_{ij} \) as income allocated to the \( r \)-th branch of products. It is well known that a necessary and sufficient condition for the demand functions of products within a group to depend only on prices within the group and income allocated to the group, is that the utility function be weakly separable, i.e., a utility tree. If the good in question is an intermediate good, then a weakly separable production function for final output is assumed, with analogous results. With this understanding, we conduct the discussion in terms of utility functions. Thus, with a weakly separable utility function, prices outside the \( r \)-th branch affect the purchases of products within the branch only through their impact on \( y_{ij} \) and the demand functions for \( x_{ij} \) can be written without explicit reference to prices outside the branch:

\[
x_{ij} = f(\phi_{ij}, y_{ij}) \quad \text{for all } r \text{ and } j
\]

where \( \phi_{ij} \) is the vector of prices of the \( r \)-th branch.

**APPLICATION TO A MODEL OF WORLD STEEL TRADE**

Consider a model of steel trade flows in which, for the purpose of modelling a restriction on imports, we group the world into three regions: South Korea (K); the regions that are restraining imports, the United States and the European Community (U); and the rest of the world (R). Following the Armington assumption, we assume that consumers regard products from different regions as differentiated. Jondrow et al. (1982) have documented a number of non-physical characteristics of steel that differentiate foreign and domestic steel. The two most important are: if one relies on foreign steel, one must order further in advance and await delivery. Thus, larger inventories must be held with associated warehousing and inventory costs; and (2) domestic steel offers greater security of supply. For these two most important characteristics they estimate the price difference that would compensate domestic users of imported steel, about 9 percent each for these two characteristics.

Then the \( r \)-th branch of the utility function (1) be steel, and the products within the branch be the products from K, U and R. Thus, each region has three demand functions for steel in the form of equation (2). Each demand function depends on three prices: the price of steel from each region. Thus, each region has nine elasticities of demand: three own and six cross.

The market shares of the three regions are listed in table 1. For the regions K and R, I use the Armington elasticities. For the region U, which was the most crucial to the estimate, a set of estimates may be based on the work of Grossman (1982). I use Grossman's "iron and steel shapes, angles and sections" as a proxy for steel mill products, and let developing countries, non-US developed countries and the US in Grossman be proxies for Korea, the rest of the world and the US-EC, respectively, in what follows. The elasticities for the US-EC, which are adapted from Grossman, are presented in table 2. We also present, in table 2 the calculated value of the modified Cournot aggregation condition. This condition is derived and explained in the next section.

Since Grossman only estimated import demand equations, the middle row of table 2 is not available from Grossman. We may use the Slutsky equation, however, to obtain approximations for the missing elasticities. Ignoring separability for the moment, consider the case where the consumer maximizes utility over a goods subject to a budget \( y \). The Slutsky equation in elasticity form is:

\[
e_{ij} = z_{ij} - S_{ij} p_{ij}, \quad j = 1, \ldots, m
\]

where \( e_{ij} \) is the Marshallian elasticity of demand of the \( j \)-th good with respect to a change in the price of the \( j \)-th good; \( z_{ij} \) is the analogous income compensated elasticity of demand; \( S_{ij} \) is the share of the consumer's income spent on \( j \); and \( p_{ij} \) is the elasticity of \( x_{ij} \) with respect to income. Define: \( Z_{ij} = z_{ij} p_{ij} \). We have that \( Z_{ij} \) from symmetry of the pure cross-substitution effects in the Slutsky equation. It follows that:

\[
z_{ij} = S_{ij} e_{ij}/p_{ij}
\]

From (3) we have

\[
e_{ij} = z_{ij} - S_{ij} p_{ij}
\]

Substitute for \( p_{ij} \) from (4) into (5), and solve for \( z_{ij} \) in both (3) and (5) to get:

\[
e_{ij} + S_{ij} / p = z_{ij}
\]

Rearrange to get:

\[
e_{ij} - S_{ij} / p = z_{ij} - S_{ij} p
\]

Since the share \( S_{ij} \) is the share of expenditure on the \( j \)-th product in the total consumer's budget, not just the share allocated to steel, the share of any particular product such as Korean or US-EC steel is small. Moreover, income elasticities of steel products from different countries are not likely to be significantly different. Thus, we may closely approximate the right hand side of (7) by zero and obtain:

\[
e_{ij} = -S_{ij} / p
\]

We seek \( e_{ij} \) and \( S_{ij} \), where we have estimates of \( e_{ij} \) and \( S_{ij} \), from Grossman.

### Table 1

<table>
<thead>
<tr>
<th>Region</th>
<th>Tons (1000)</th>
<th>Sper Tons</th>
<th>Value of Shipments ($1000)</th>
<th>Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>2035</td>
<td>300</td>
<td>610,500</td>
<td>0.007</td>
</tr>
<tr>
<td>US-EC</td>
<td>143751</td>
<td>532</td>
<td>76,496,812</td>
<td>0.040</td>
</tr>
<tr>
<td>Rest of the World</td>
<td>23948</td>
<td>410</td>
<td>9,818,680</td>
<td>0.123</td>
</tr>
<tr>
<td>Total</td>
<td>169794</td>
<td></td>
<td>86,925,952</td>
<td>1</td>
</tr>
</tbody>
</table>


### Table 2

<table>
<thead>
<tr>
<th>Region</th>
<th>Elastcity of US Demand for Steel from</th>
<th>Given Change in Price of Steel of</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>4.512</td>
<td>K</td>
</tr>
<tr>
<td>U</td>
<td>0.098</td>
<td>U</td>
</tr>
<tr>
<td>R</td>
<td>2.306**</td>
<td>R</td>
</tr>
</tbody>
</table>

Modified Cournot Aggregation (equation 14)

\[
2.306 - 0.098 = -0.318 - 0.660
\]

* \( m = 2 \) and \( m = 3 \) are the alternate values of \( e_{ij} \) and the modified Cournot aggregation condition, respectively, for a change in the Korean price based on change discussed in the text.

Source: Adapted from Grossman (1982), table 1 and equation (14) as explained in the text.
From (8) and table 1, 2 we have:

\[ e_{0K} = e_{0K} + (S_0/S_0) \cdot 0.8 = 0.070 \cdot 1.125 = 0.080 \]

and

\[ e_{0R} = e_{0R} + (S_0/S_0) \cdot 1.575 \cdot 0.007 = 0.002 \]

That is, in table 2, the entries in rows K and R (without parentheses) have been taken from the estimation of Grossman. The values .080 and .002 in table 2 are derived from the Slutsky equation and the other values in table 2, as explained by equation (9).  

From table 2, we observe that the calculated value of the modified Cournot aggregation condition is negative, if the price of steel from the region U or the region R changes, but it is equal to .272 for a change in the Korean price (the value in parentheses is discussed below). The positive value of the modified Cournot aggregation condition in the case of a Korean price change means that more income is allocated to steel producers when the price of Korean steel increases in the US-EC. When the price of steel from the region R or U increases, however, no additional income is allocated to steel producers. In effect, the elasticities, with respect to a change in the Korean price of steel in the US-EC, are not constrained by the original budget allocation to steel, but the other elasticities are. This asymmetric treatment of the consumer's budget allocation to steel products, depending on which nation's steel prices change, should cause one to be very skeptical of the estimated elasticities. We ask, therefore, of which of the elasticities in table 2 should we be skeptical, and can the modified Cournot aggregation condition amit us in identifying alternative elasticity values?  

We note, taking \( e_{0K} = 4.503 \) as given, that from (8) (our approximation from the Slutsky equation) \( e_{0K} \) should take the value:

\[ e_{0K} = e_{0K} + (S_0/S_0) = 4.503 \cdot 0.007 = 0.028 \]

In table 2, however, \( e_{0K} \) (without parentheses) takes the value 2.018. If we substitute .028 for \( e_{0K} \) in table 2, then the modified Cournot aggregation condition, for a change in the Korean price, is reduced to the more plausible value of .0075 (inserted in parentheses in table 2, as the new value of the modified Cournot aggregation condition). This value of the modified Cournot aggregation is more plausible, because, as in the case of a price change from the region R, with \( e_{0R} = 2.018 \), it implies that the consumer is not spending significantly more on steel when the price of steel from Korea increases. Moreover, Grossman's standard error for \( e_{0K} \) is high in relation to his other standard errors, so that a ninety percent confidence interval for this variable would include negative values. Thus, also based on statistical tests, it seems more reasonable to take \( e_{0K} = 2.018 \).  

Alternatively, we could turn equation (11) around and solve for \( e_{0K} = e_{0K} + (S_0/S_0) \) given \( e_{0K} = 2.018 \). This would give a plausible value of \( e_{0K} = 37.15 \), which in turn would increase the value of the modified Cournot aggregation condition, for a change in the price of steel from the rest of the world, to .175. That is, in order to obtain a value of the modified Cournot aggregation condition that does not vary significantly across regions, and which does not allocate significant amounts of additional income to steel when the price of steel increases, it seems more reasonable to take \( e_{0K} = 2.8 \), and leave the value of \( e_{0K} \) unchanged. This means that the income elasticities, with respect to a change in the price of steel from the three regions, will be much closer to each other.  

In summary, the modified Cournot aggregation condition indicates that at least one of the elasticities with respect to a change in the price of Korean steel in the US-EC is not accurate. Statistical tests identify a problem with \( e_{0K} \) and the Slutsky symmetry used is used to obtain an alternate estimate. The modified Cournot condition is utilized to identify that the problem is with \( e_{0K} \) rather than \( e_{0K} \). Failure to recognize this inconsistency in the elasticity estimates would lead to perverse results in the model for which these elasticities were developed. In particular, these elasticities were employed in a three region model of world trade in steel (Yaffe, 1979). The impact of the US and EC extensive system of voluntary export restraints, on world trade in steel was simulated. With the elasticities of table 2, the

US-EC consumed more steel after the imposition of the voluntary export restraints and the resulting price increases. This apparently perverse result is a consequence of the significant high income elasticity of demand with respect to a change in the price of Korean steel, and is corrected when \( e_{0K} = 2.018 \) is replaced with the more reasonable value of .28.  

THE MODIFIED COURNOT AGGREGATION CONDITION  

We now derive the principle result of the paper which we have already seen to be of use in the previous section. With a weakly separable utility function the consumer's decision problem can be viewed as a two-stage maximization procedure. The consumer first optimally allocates expenditure among the broad commodity groups corresponding to the six branches of the utility function. This determines the budget allocation for each branch, where \( \sum x_i y_i = y \). The consumer then maximizes a branch utility function subject to income allocated to the branch. The budget constraint for the r-th branch is:

\[ \sum x_i P_{r,i} = y \quad r = 1, \ldots, m \]

Partially differentiate both sides with respect to \( P_{r,i} \) to get:

\[ \sum x_i \frac{\partial x_i}{\partial P_{r,i}} + x_i = \frac{\partial x_i}{\partial P_{r,i}} \quad k = 1, \ldots, s \]

Multiply each term in the sum on the left by one in the form of \( x_i / x_i \) and multiply both sides of (13) by \( P_{r,i} / y \) to get:

\[ \sum x_i \frac{\partial x_i}{\partial P_{r,i}} + x_i = \frac{\partial x_i}{\partial P_{r,i}} \quad k = 1, \ldots, s \]

where

\[ x_i = \frac{\partial x_i}{\partial P_{r,i}} \]

\[ S_i = \frac{P_{r,i}}{y} \]

are, respectively, the elasticity of the jth product in the r-th branch with respect to a change in the price of the k-th product in the r-th branch, and the share of income allocated to the r-th branch spent on the j-th product in the r-th branch.  

The left hand side of (14) is directly analogous to the condition Frisch (1959) has called the Cournot aggregation condition. The latter condition applies when a consumer maximizes utility over all goods, not just over goods within the branch, and is independent of weak separability. The summation on the left side of (14) is a weighted average of the own and cross-price elasticities of demand for products within the branch, where the weights are the respective shares of expenditure on all products in branch r. On the left side, the share of the product whose price has changed is added to the weighted average of the elasticities.  

Unlike the analogous Cournot aggregation condition, the right hand side is not equal to zero, because a change in the price of a product within a branch has an effect on income allocated to the branch. The right hand side is the elasticity of income allocated to the branch with respect to a change in the price of the k-th product within the branch. If we think of cross-price elasticities as being nonnegative, the smaller the elasticity of income allocated to the branch with respect to a change in the price of the k-th product within the branch, the smaller the cross-elasticities (with respect to a change in the price of the k-th price) must be in relation to the own elasticity.  

In general, the sign of the right hand side of (14) is unknown. Conventional empiricism would suggest, however, that regardless of which price within the branch that is changing, these income elasticities should
possess the same sign; moreover, one would not expect them to vary widely within a branch by more than a proportionality factor reflecting the share of branch income spent on the good. That is, if the branch is clothing, and the products are men's suits and men's shirts, then we would expect the ratio of the elasticities of income spent on clothing with respect to a change in the price of men's suits or men's shirts, would approximately equal the ratio of the shares of branch income spent on these goods, respectively. If the elasticities, when substituted into the left hand side of (14), imply very different elasticities of income allocated to clothing, depending on whether the price of men's suits or shirts is changing, this should be a cause of considerable skepticism regarding the elasticities. In such cases, the researcher has a number of alternatives. One is to examine the statistical tests of the price elasticities. If one price elasticity is particularly doubtful, one can accept the implied income elasticity from the product whose price elasticities pass statistical tests, as applying to the other products in the branch as well, given this elasticity of income with respect to a price change, for any other product within the branch, equation (14) will enable solving for a single price elasticity. Alternatively, the Slutsky symmetry condition may be utilized, along with equation (14) and available statistical tests, to guide the researcher toward an appropriate substitution of elasticities. As discussed above, the modified Cournot aggregation condition was combined with statistical tests and the Slutsky symmetry condition, to avoid perverse results in an applied model of world steel trade.

APPLICATION TO THE CES FUNCTION

The CES function is the basis of the often applied Armington model. The elasticities $e'_k$ have been derived by Armington (1969, equation 26) for the CES utility function case. They are:

$$e'_k = S_k (1 - n)$$

for $k = 1, r - 1, m$.

and

$$e'_k = -[1 - S_k n_k + S_k m_k]$$

for $k = 1, r - 1, m$.

Where

$$e'_k = \frac{\delta q_k}{\partial \ln p_k} / \frac{\delta \ln y_k}{\partial \ln 1}$$

is the common elasticity of substitution between products in the CES function, and

$$n_k = \frac{\delta q_k}{\partial \ln p_k} / \frac{\delta \ln y_k}{\partial \ln y_k}$$

is the elasticity of demand (defined to be positive) for the kth branch of goods, and p is the price of the aggregate good

If we substitute from (15) and (16) into (14) we get:

$$\sum S_k e'_k + S_k (1 - n) =$$

$$k = 1, m.$$

A Bean-Brick Parable: "Consumer Sovereignty" Yet Again

Martin Brandenbumer*

All the greater mistakes in economic policy arise from focusing upon the interests of people as producers rather than upon their interests as consumers, that is, from acting on behalf of producer minorities rather than on behalf of the whole community as sellers of services and buyers of products. One gets the right answers usually by regarding the interests of consumers, since we are all consumers.—Henry Simons

Lord Finchley tried to fix the electric light
Himself. It struck him dead, and served him right.

It is the duty of the wealthy man
To give employment to the artisan.

Hilaire Belloc

Two unrelated circumstances prompt this re-examination of the threshhold problem. A personal circumstance is the re-printing of a generation-old essay of mine, with which I so long ceased to agree, and which I should like to amend. The other circumstance is the current disorder in international trade and in trade theory. I refer particularly to the popular charge that the United States, supposedly having its industrial policy (or lack of one) on the consumer interest, has lost out in international economic competition to other countries, notably Japan, who have based their own industrial policies on producer interests.

In such arguments, it is interesting to note, gains and losses are measured by balances of commodity trade—or on current account, if "invisible items" are included. A surplus of sales over purchases indicates "wasting" without regard to consumer satisfaction, and a surplus of purchases over sales indicates "losing" with the same disregard of the domestic consumer. (Good 17th-century mercantilism, including its disregard of the consumer, all dressed up in 20th century statistics.)

The pro-consumer head-note to the present essay is from Henry Simons (1899-1946) rather than from Frederic Bastiat (1801-1850), Simons' predecessor by almost precisely a century. This choice is made less in deference to my former teacher (Simons) than to Simons' having advanced the argument in an important particular. He sees the consumer as simultaneously a buyer of goods and a seller of services; Bastiat sees him only as a buyer of goods, leaving his sale of services out of account. Simons' consumer is a full participant in the economic process. Bastiat's consumer may be a passive purchaser and simple. One can

*School of International Politics, Economics, and Business, Aoyama Gakuin University (Tokyo, Japan).