

Industry Definition and Less Than Fair Value Pricing: an Analysis of ITC Practice

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Abstract

In reaching an injury determination in U.S. antidumping and antisubsidy cases, the potentially injured domestic industry and thus scope of an investigation must be defined. However, a systematic process of market definition has yet to evolve in ITC decision making, leaving the question to instead be considered on a case by case basis. Cluster analysis of commuter aircraft cases suggests that current ITC practice may often lead to a definition of domestic industry which is too narrow.

I. Introduction

The antidumping and countervailing duty statutes provide remedies for U.S. industries injured by imports priced at *less than fair value* (LTFV).¹ In

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1. Less than fair value exists if the price of the goods sold in the U.S. is less than the price for which they are sold in the exporting country. If not enough exporting country sales were made to permit a comparison, then constructed value, or another measure, may be used by the Department of Commerce (DoC).

most of the cases which it hears, the United States International Trade Commission (ITC) is required, before tariffs may be imposed, to determine that the domestic industry has been either injured, threatened with injury, or materially retarded by reason of dumped or subsidized imports. In the process of reaching an injury determination in an LTFV case, a necessary first step for the ITC is to define the relevant potentially injured domestic industry and thus the scope of its investigation. The relevant industry is defined by statute to be those firms producing the *like product*. Like product is in turn *a product which is like, or in the absence of like, most similar in characteristics and uses with, the article subject to an investigation*. The definition of *like product* is important yet problematic in LTFV decision making. The initial decision by the ITC regarding products and firms which should be included in subsequent analysis may be pivotal in determining both injury and dumping or subsidy margin and thus the final disposition of the LTFV case. However, a systematic process of market definition has yet to evolve in ITC decision making, leaving the question to instead be considered on a case by case basis.²

Applebaum and Grace [1987] call domestic industry definition *a critical threshold issue*. International trade lawyers also find current ITC practice to be problematic. Wood [1989] notes that "since the ultimate injury determination will depend on the scope of the *like product* definition found by the Commission, the first step the Commission can take toward improving the predictability and economic accuracy of its decisions is in refining its market definition process." Steen [1987] notes that, "Ambiguous statutory language and confusing legislative history have resulted in *like product* definitions that are, at times, inconsistent and unpredictable...., the Commission's current definition of *like product* is underinclusive."

In this paper, we suggest that cluster analysis provides a ready definition of *like product* for those classes of products characterized by measurable linearly independent attributes. Such an attribute-based approach differs significantly from the criteria typically employed by the ITC in deciding LTFV cases (USITC [1992]). We provide an example of the use of cluster analysis,

2. Others have noted that injury to the domestic industry is similarly ill defined (see, e.g., Grossman [1986] and Pindyck and Rotenberg [1987]).

its data requirements and results, using the U.S. commuter airplane industry, which brought countervailing duty cases against imports in the 1980s. In these cases, ITC Commissioners raised questions regarding perceived ad hoc methods of *like product* and thus industry definition. The usefulness of the present analysis is in its systematic consideration of what constitutes a *like product* and thus what constitutes the relevant domestic and foreign industry.

Section II of the paper provides an overview of LTFV cases. Industry definition issues are examined in Section III. Section IV presents a brief history of the commuter airplane industry during the 1980s and a description of the commuter airplane cases decided by the ITC. Section V describes a data set constructed on the commuter airplane industry as it existed over the years 1979-1988, along with the corresponding cluster analysis. Final comments are presented in Section VI.

II. Antidumping and Countervailing Duty Actions

The United States decided close to one thousand antidumping and anti-subsidy cases over the decade of the 1980s. These mechanisms have grown in importance in the United States and elsewhere even as average tariff levels have fallen under the auspices of the General Agreement on Tariffs and Trade (GATT). These, along with mechanisms such as the voluntary export restraints negotiated with Japan on behalf of domestic auto makers, or the Multifibre Arrangement for textiles, or the escape clause, which provides protection to industries threatened by GATT-sponsored trade barrier reduction, are important components of the U.S. trade regime. Countervailing duty (CVD) and antidumping (AD) statutes are nominally justified as attempts to provide a *level playing field* for U.S. import-competing industries and negate foreign competitive advantage arising from intervention by government or unfair business practices. The field is leveled through the imposition of offsetting duties sufficient to eliminate the subsidy or dumping advantage.

In CVD cases, competitive advantage is alleged to have been conferred by subsidy in the home country. The Department of Commerce (DoC) will find foreign subsidy schemes to be countervailable if they result in the provision

of an input to exporters at a lower price than to producers of domestically-sold products. The DoC has found, for example, that when only exporters are eligible for pre-shipment government loans, they are countervailable to the extent that they are provided at preferential rates (U.S. Department of Commerce[1991]). Industry or sector specificity is the key concept in determining whether a foreign subsidy is countervailable. For example in the Wire Rope from India case, the DoC verified that a wide variety and broad range of industries had benefitted from the provisions of India's SICA (Sick Industrial Company Act). Therefore, it was determined that SICA did not confer a countervailable subsidy. Countervailing duties, if imposed, are of a magnitude sufficient to offset the estimated value of the subsidy.

Dumping presumably is the result of autonomous profit maximizing pricing decisions by foreign producers (see, for example, Staiger and Wolack [1992], Prusa [1992], Anderson [1992] and Hartigan [1993]). Several reasons for selling below (marginal) cost are well-known, including sales maximization, uncertainty about future export price at the time of undertaking production, and predation. Of these, only predation would appear to have potential negative social welfare implications. Most observers suggest that predatory behavior is relatively rare when markets are contestable. Additionally, Horlick [1989] finds that U.S. antidumping practice is to penalize sales at less than *fully allocated cost* or average total cost. He notes that this is a different standard of cost than is used for domestic goods in antitrust cases and may thus violate the GATT requirement that foreign and domestic goods be judged by the same standards.

When the exporting nation in an LTFV case is either a signatory to the GATT subsidies code or has implemented a similar code, or has been accorded most favored nation status, the possibility of injury to the domestic import-competing industry must be established before duties can be imposed. While the Secretary of Commerce is responsible for the injury test. The decision procedure is thus bifurcated for both AD and CVD cases, involving a countervailable subsidy (for CVD cases) or a dumping (for AD cases) finding by the Department of Commerce (DoC) and an injury finding by the ITC. Identical criteria are used by the ITC for both antidumping and antisubsidy investigations to determine whether a domestic industry is either injured, threatened with injury, or is materially retarded in establish-

ing itself (Wood [1989]).³

The essence of the process is an initial industry definition and a preliminary ITC determination of possibility of injury, followed by preliminary and final decisions by the DoC as to whether those particular products are being sold at less than fair value. If these determinations are affirmative, the process ends with the ITC final determination of injury.

LTFV petitions are filed simultaneously with DoC and the ITC by an interested party. The decision regarding the definition of *like product* and thus the domestic industry is made shortly after the filing of a sufficient petition. Within 45 days, the ITC must render a preliminary decision as to whether a domestic industry has been materially injured, is threatened with material injury, or whether the establishment of a domestic industry is materially retarded by reason of subsidized or dumped imports. If the preliminary determination is negative, the case is terminated.⁴ The DoC must decide within 85 days of filing whether a subsidy has been provided, directly or indirectly, and must determine the amount of the subsidy. If this decision is negative, the DoC investigation continues and if it is affirmative, DoC requires that a bond be posted by the importer in the amount of the estimated net subsidy. The DoC normally makes a final decision within 75 days of its preliminary determination. The ITC normally makes a final determination within 45 days of the final DoC decision. An affirmative decision results in an order by DoC to Customs to collect a cash deposit equal to the estimated duty on the affected imports.⁵

III. Definition of *Like Product*

Many aspects of the LTFV mechanisms have been examined in the international economics literature.⁶ Recent scholarly efforts have addressed pos-

3. Hartigan, Kamma and Perry [1990] have studied the bifurcated injury determination procedure of the ITC.

4. In dissenting from the majority opinion of no injury in the Commuter Airplanes from Brazil case, Commissioner Frank noted the difficulty of surveying producers, importers and domestic purchasers of the products subject to investigation during the several weeks which are available before making the preliminary determination.

5. See Harper and Huth [1992] for a schematic exposition of this process.

sible developed vs. less developed country discrimination, the nature of products which are brought under investigation, firm-specific rationales for LTFV pricing, possible systematic biases associated with decision making, wealth effects for firms involved in these cases, as well as other issues. Our concern in this paper is with what constitutes a *like product*, and thus the appropriate scope of an LTFV investigation, a topic which has received relatively little attention from economists.⁷ Before either a determination of the existence of sales at LTFV or a determination of injury can be made, the relevant domestic *like product* must be identified and the corresponding domestic industry which produces it and finally the market in which it is sold, must be defined.

A. ITC Practice

The procedure for determining products to be included, and thus the scope of the LTFV investigation, necessarily begins within a few days of the initiation of an investigation. Due to time constraints, the ITC must rely on the best available data to determine *like product*. Typically, this will be the information included by the domestic import-competing industry in their petition, as well as other preliminary information which can be gathered from producers identified during this time frame. Domestic industry definition may change while an investigation is in progress, based on information collected during the course of the preliminary investigation.

Applebaum and Grace [1987] find that the ITC, in defining *like product* and thus domestic industry, has traditionally focused on five factors: customer and producer perceptions, physical appearance, commercial interchangeability, channels of distribution, and common production equipment and employees. The Commission itself defined its criteria in 1992 as follows:

6. The pathbreaking analysis of the determinants of ITC decisions is found in Finger, Hall and Nelson [1982]. Hartigan, Kamma and Perry [1989] analyzed the effects of antidumping decisions from a capital market perspective.

7. Levinsohn and Feenstra [1990] use of a hedonic regression to identify competitors in the 1987 U.S. new car market and suggest that such techniques can be used with multi-dimensionally differentiated products.

In making the *like product* determination, the Commission generally considers a number of factors including: (1) physical characteristics and uses, (2) interchangeability, (3) channels of distribution, (4) common manufacturing facilities and production employees, (5) customer or producer perceptions, and, where appropriate (6) price. The Commission may consider other relevant factors based upon the facts of a particular investigation. The Commission looks for clear dividing lines between *like products*, and has found minor distinctions to be an insufficient basis for finding separate *like products*. The Commission's *like product* determination is essentially a factual one and is made on a case-by-case basis. (USITC [1992])

The critical threshold nature of this initial *like product*/domestic industry definition is clear when one considers the sequential nature of the administered protection process. Firms which are included in the domestic industry definition are then subject to financial investigation as the ITC attempts to determine injury. In this assessment of potential injury, the Commission must (by statute) consider, among other factors:

production, shipments, capacity, capacity utilization, inventories, employment, wages, financial performance, capital investments, and research and development expenditures. No single factor is dispositive, and in each investigation we consider the particular nature of the industry involved and the relevant economic factors which have a bearing on the state of the industry. (USITC [1992])

The sequential nature of the industry definition/injury assessment process implies that the initial definition of *like product* and consequent inclusion of some firms and exclusion of others from the injury calculations can have an impact on the injury finding. Consider, for example, decisions by the ITC in the antisubsidy cases involving cut flowers from various Latin American countries (USITC cases 731-TA-327 through 334) in which both LTFV pricing and injury or threat of injury to segments of the U.S. cut flower industry were found. These cases were subsequently remanded for further consideration to the ITC by the Court of International Trade.

The Court remanded the case to the Commission to reconsider, among

other things, the *like-product* determinations. The Court noted that these determinations could dictate the outcome of the investigations: *'If flower types are combined, some of the affirmative opinions may become negative. On the other hand, analysis on the basis of several like products may cause a negative determination to become positive on the threat issue.'* (USITC [1988])⁸

Acting Commission Chairman Anne Brunsdale, in writing the dissent from the majority decision in the cut flowers cases, found that substitutability among cut flowers was the most difficult issue facing the Commission during the investigations. In these cases, even upon reconsideration, the majority of Commissioners stuck with the original (narrow) definition of *like product* and found injury or threat of injury to a sufficient number of domestic producers to warrant several affirmative final injury determinations.

B. Alternative Definitions of Like Product and Market

An obvious parallel to the LTFV statutes is found in domestic antitrust statutes.⁹ Notably, little consensus regarding like product (among other issues) and thus the market scope in other than a perfect competition or pure monopoly context exists, instead; a functional definition has evolved through case law. Posner [1976] notes that it is the difficulty of measuring the relevant elasticities which causes market definition problems to arise in antitrust analysis. Here, market definition has come to embrace both prod-

8. If *like product* definition were expanded to include products with lower cross price elasticities, a greater range of products would be included, implying that more firms would likely be examined that would not be injured by import competition. Thus, the ITC would be less likely to find injury, a decision which, as was noted above, many economists would think of as welfare enhancing. Since an expanded definition of like product means that more domestic producers are being compared to an unchanged range of imported products and producers, imports covered by tariff would be unchanged.

9. In defining what constituted "*like grade and quality*" in a 1980 dumping suit, the court held that the Antidumping Act was "intended to complement the antitrust laws by imposing on importers substantially the same legal strictures relating to price discrimination as those which had already been imposed on domestic businesses by the Clayton Antitrust Act of 1914." (quoted in Victor [1983]).

uct line and geographical considerations, as legal scholars have sought to develop workable proxies for these underlying cross price elasticities.

The Department of Justice addresses appropriate market definition in its Merger Guidelines. The Guidelines state that a market is "a group of products and an associated geographic area such that (in the absence of new entry) a hypothetical, unregulated firm that made all the sales of those products in that area could increase its profits through a small but significant and non-transitory increase in price (above prevailing or likely future levels)." In practice, a 5% price increase for the suggested range of products is hypothesized and market effects are examined. Stigler and Sherwin [1985] are of the opinion that Herfindahl measures used in studies of market concentration are superior to the current merger guidelines.

Horowitz [1981] argues that, lacking clear-cut definitions of market, regression analysis of joint price variations across potential products and geographic areas provides "a meaningful, understandable and implementable means for delineating markets." Stigler and Sherwin examine the speed of price convergence in possible single markets. They suggest that two products should be considered to be in one market when their relative prices maintain a stable ratio, although *no unique criterion exists* (p 562) for assessing this ratio. Again, these methods are suggested to be essentially equivalent to the *more common definition* of high cross-elasticities of demand or supply. That is, *ex post*, it can be imputed that two products are similar when their relative price ratio is stable. From the literature, it is not clear that a consensual understanding of how to identify a *like product*, and, especially in antitrust, a single market, has evolved." ¹⁰

Price ratio comparisons such as these commentators suggest lend themselves much more easily to certain types of goods than others. Stigler and Sherwin suggest that unleaded and leaded gasoline were substitutes over the 1979-82 period (measured monthly) and that hard winter wheat and soft wheat were substitutes, although durum was not, over a 65 month period.

10. For many internationally traded goods, transportation costs are low relative to value, making local and regional markets less important than in antitrust. Thus, *like product* is the more meaningful discriminant in defining the scope of the market in LTFV cases (although Japanese cement producers have recently been found to injure the Southern California cement industry with dumped imports).

Yet, it is easy to imagine cases in which a reasonable price series could not be constructed. Price series may not be available for, for example, cut flowers, as they are for petroleum products. Many modern products may be too sophisticated, too adaptable to changing consumer tastes and technology innovations, to establish reliable price series across a broad range of producers and sellers.

Modern trade is based less and less on homogeneous basic commodities and is increasingly based on products which are differentiated to a degree from their competitors. The Commission of the European Communities has already asserted that firm- (and thus product-) specific comparisons of dumping margins is impossible in some LTFV cases because of lack of sufficient standardization of features and price in products which were nonetheless thought to be viewed by consumers as substitutes.¹¹ Along the same lines, the ITC has had to establish rules regarding potential imports of similar but not identical products, to prevent easy evasion of LTFV duties. For example, in the Brother vs. Smith Corona case, the ITC heard arguments about whether adding a chip to a typewriter to give it a memory made it no longer a *like product*. The increasingly sophisticated nature of internationally traded products and the increasingly flexible production processes in which they are produced, along with identified weaknesses in current ITC practice, warrant new approaches to *like product* definition.

IV. Like Products in the Commuter Airplane Industry

In this section we examine the performance of the U.S. commuter aircraft industry, which brought two LTFV cases against foreign competitors during the 1980s. In subsequent sections we develop a data set which embodies product characteristics relevant to potential aircraft purchasers and examine alternative *like product* definitions using cluster analysis. This analysis suggests that the ITC *like product* definition used for these antisubsidy cases

11. The EC Commission (which is charged with handling antidumping cases) was unable to assign product-specific duties in the VCR's from Japan case (and several other cases) because they were unable to sort out the products to an adequate degree.

was underinclusive.

It is clear that the U.S. commuter and business aviation industry declined during the early 1980s. From 1981 to 1984, the nominal value of domestic and export shipments declined from \$2.9 billion to \$1.9 billion, while capacity utilization fell from 70% to 18% (USITC 1986 ix). Factors which at least partially explain this performance include a slowdown in growth rates, particularly in the U.S., high interest rates and the appreciation of the U.S. dollar. Over the 1980-84 period, the industry laid off 17,000 employees.

Those producers who provided information to the ITC cited producers in the U.K., France, Canada and Brazil as their most important competitors in the commuter airplane industry. Not only macroeconomic conditions, but specific business practices were said to contribute to foreign advantage during this period. U.S. industry sources cited government support of sales financing, protection of home markets and perhaps access to government subsidy as providing competitive advantage. Product liability expenses were estimated to amount to as much as 30% of purchase price of a U.S. airplane, well beyond foreign costs.

It was in this economic environment that on May 27, 1982, Commuter Aircraft Corporation (CAC) of Youngstown, Ohio, filed a petition alleging that certain commuter aircraft from France and Italy benefited from countervailable subsidies. CAC alleged that they would be injured due to unfair import competition with the CAC-100, which was then being developed. The allegedly subsidized import was the ATR-42, subsequently brought into production in 1985 by Societe Nationale Industrielle (France) and Societa Aerospaziale Italiana (Italy).¹² In response to inquiries by the ITC, commuter airline companies noted passenger capacity as the single most important factor in the acquisition decision. Important secondary criteria were price, quality and financing. Tertiary factors included fuel efficiency, product reputation and range.

The ITC instituted an injury investigation with respect to the relevant

12. The Commission stated that in an industry such as aircraft, where sales are made well in advance of production and delivery, it is appropriate to investigate subsidized imports still under development. It is clear that both the domestic and imported aircraft were still at least 2 years from delivery when the case was decided.

domestic industry and solicited information regarding aircraft of 60 seats or less. The CAC-100 was found to constitute the *like product* and thus CAC was the domestic industry potentially subject to material injury. The Commission ended consideration of this case on July 7, 1982, with a preliminary determination (by a vote of 3-1) that the domestic industry was neither materially injured, nor threatened with material injury, nor was the establishment of a domestic industry materially retarded by reason of subsidized imports.

The Commissioners noted in this case that, "the limited nature of CAC's sales efforts, particularly the unavailability of specification documents, has seriously restricted CAC's access to the market and has prevented it from competing seriously for sales" (p. 11). The ITC case reports show that the no injury by reason of subsidized imports conclusion was at least partly due to the early stage of development of the CAC-100 when the case was brought. Had the aircraft been farther along in the development process, including securing advance sales, the outcome of the case might have been different. The CAC-100 was subsequently withdrawn from development.

On August 13, 1982, Fairchild Swearingen Corporation of San Antonio, Texas, filed a petition alleging that the Bandeirante, manufactured by Embraer of Brazil, benefited from countervailable subsidies. The ITC determined that the Fairchild Swearingen Metro III and the Beech Corporation C99 were the domestically produced airplanes which "have characteristics which correspond most closely to the Bandeirante." The Commission voted 3-1 on September 21, 1982 that the domestic industry (consisting of Fairchild and Beech) was neither materially injured nor threatened with material injury, nor was the establishment of a domestic industry materially retarded by reason of subsidized imports. As with the CAC case, the negative preliminary injury decision ended the case before the DoC considered the issue of less than fair value pricing.

The 1986 USITC competitive assessment of the commuter and business aircraft industry retrospectively validated the 1982 findings of no injury by reason of subsidized imports insofar as it attributed some 90% of the decline in the industry to overall demand factors, rather than unfair trade practices. Thus, even if the like product definition used by the ITC in 1982 were to have been too narrow or too broad, the ITC presumably would have

reached an identical determination under a different industry definition, given the apparent cause of the commuter aviation industry's difficulties.

For the present analysis, the salient issue addressed in the ITC case reports was the determination of which aircraft constituted a *like product*. Number of seats was the variable most frequently referred to in the case reports by the Commissioners in their discussion of *like product*. However, in dissenting from the majority view in the CAC case, Commissioner Frank noted that a focus on seating capacity alone led to a narrow and inadequate definition of *like product* (USITC [1982 July]). To ascertain the extent to which the ITC *like-product* and thus domestic industry definition in these cases may have been appropriate, we use cluster analysis to group various commuter aircraft on the basis of both physical and performance characteristics.

V. Data Description

A data set was constructed on all aircraft which might potentially have been included in the ITC analysis as part of the relevant industry. The aircraft data were compiled from the annual issues of "Handbook of Business and Commercial Aviation." The commuter airplanes section of the Handbook contains information on physical characteristics, performance and prices of aircraft equipped according to certain specifications. A data set of 263 observations was constructed containing data on aircraft characteristics for 10 years (1979-1988). The sample size varied in different years according to the number of aircraft included in the Handbook in that particular year. In the 10-year period for which data were collected 68 unique models were identified.

We selected the following subset (due to linear dependencies) from the some 41 aircraft attribute variables identified for use in the classification analysis:

SEATING: this variable represents maximum passenger seating capacity including crew.

TURN: this is a measure of external length and measures the radius of a 360 degree turn on the ground.

BAG: this measures luggage capacity in terms of volume per passenger.

PWOSHE: this variable measures shaft horsepower.

RATEALL: this is rate of climb in feet per minute with all engines operating, at maximum takeoff weight, at sea level, with International Standard Atmosphere (ISA) conditions.

TAS: this is a measure of temperature and pressure corrected indicated airspeed in knots (true airspeed).

ENGINE: this is a binary variable to differentiate models where power was indicated as horsepower from those indicated as shaft horsepower (reciprocating vs turbine).

Missing values in some the variables chosen reduced the set to 50 observations.

A. Cluster Analysis

Clustering is an exploratory and descriptive method for grouping multivariate data based on measures of Euclidian distance across product characteristics. The goal of clustering is to identify groups of products with characteristics which are similar within the group but distinct between groups. Performing a multi-attribute classification of products with observable and measurable attributes provides a thorough and clear definition of *like products*. Such a method, when feasible, is more comprehensive and methodologically superior to the ad hoc comparison methods used by the ITC. Relative to the regression-based methods suggested in the antitrust literature, cluster analysis has the benefit that it does not require time series data on price ratios to determine substitutability.

Cluster analysis is not without weaknesses. The grouping of products (aircraft in this case study) demands large amounts of data. Also, clustering does not provide a clear definition of the number of similar groups implicit in the sample set. This disadvantage is independent of the type of products under analysis.

The detailed representation of an aircraft through a vector of characteristics can help to identify competitive products that would not otherwise be deemed feasible substitutes when seating capacity is the only feature considered. In this analysis, measures of distance are based on aircraft attribut-

es. Three issues which must be addressed in defining the clusters include: the attributes to be used across the sample, the algorithm to be used, and; the appropriate number of clusters.

As was described earlier, linear independence and major attribute representation were the two criteria used to select measures for inclusion in the cluster analysis. The aircraft clustering was performed using the 50 models and 7 characteristics described above. Seating capacity (SEATING) is one of the variables used by the Federal Aviation Administration (FAA) to define commuter aircraft. According to the FAA, an airplane is defined as a commuter aircraft if it has a seating capacity of fewer than 60 passengers and a payload capacity not exceeding 18,000 pounds. The rest of the variables included represent a linearly independent set of attributes that measure the following important features: basic aircraft characteristics, dimensions, power, weight, takeoff, climb, limits, cruise and productivity factors.

The algorithm used to classify the aircraft in the sample is based on the Euclidean distance within the cluster. The method used is Ward's (minimum-variance) algorithm, which minimizes the within-cluster sum of squares.¹³ At each step, the algorithm chooses to join clusters such that the within-cluster sum of squares is minimized over all separate clusters. The algorithm starts with n clusters where n is the number of observations (aircraft) in the data set. In subsequent stages the closest individuals are clustered together following the algorithm's minimum variance criterion. At the end of the process there is only of cluster.

The outcome of the clustering procedure is a grouping according to characteristics. At present, there is no clear method to determine the optimal number of clusters. There are, however, some indicators that can help in defining the number of groups. A primary guideline is the error variability measure. This criterion looks at the distance between different clusters. Thus, one can choose when there is relatively large jump between two

13. The metric to be minimized is:

$$ESS = \sum_{i=1}^k \sum_{j=1}^N (X_{ij} - \bar{X}_i)^2$$

where k represents the number of clusters and N the number of individuals in each cluster. The program used to run the cluster analysis was the procedure CLUSTER in the SAS (Statistical Analysis System) statistical package.

stages. The jump is interpreted as the merging of two relatively different clusters.¹⁴ Also used to define the appropriate number of groups is the graph of the fusion coefficient against the number of clusters. The flattening of this curve is an indication that further clustering does not provide additional information.

B. Results of the Cluster Analysis

The optimal number of clusters was determined by using both the error variability measure and the fusion coefficient methods mentioned earlier and the pseudo F and t^2 tests. Each test indicates that the number of clusters should be 4. The semi-partial R^2 is defined as the sum of squares between clusters divided the total sum of squares and it measures the decrease in the R^2 when two clusters are joined. A plot of the semi-partial R^2 shows that flattening occurs for $k = 4$, which again suggests four as the possible maximum number of clusters.¹⁵

Table 1 presents summary values by cluster. Clusters can be portrayed by using a profile graph, showing mean values corrected by their standard deviation. Data in Table 1 were used to compute standardized cluster mean differences from the population mean for each characteristic and the resulting values were plotted and are displayed in Figure 1. The profiles show variation in specification characteristics within and across clusters. With respect to the seating variable there is little difference between clusters 2 and 4 and both tend to contain smaller aircraft. A similar finding occurs for the engine horsepower variable which is consistent with the small versus large aircraft classification. The engine factor, which reflects a classification of aircraft according to whether a turbine or reciprocating powerplants is used, results in a situation where little difference between clusters 1, 2, and 3 is apparent (all turbine powered aircraft). Aircraft speed information indicates that a relatively small difference exists between cluster 2 and 3 while cluster 1 (4) contains appreciably faster (slower) aircraft. The turn radius, which measures size and ground maneuverability, indicates little difference

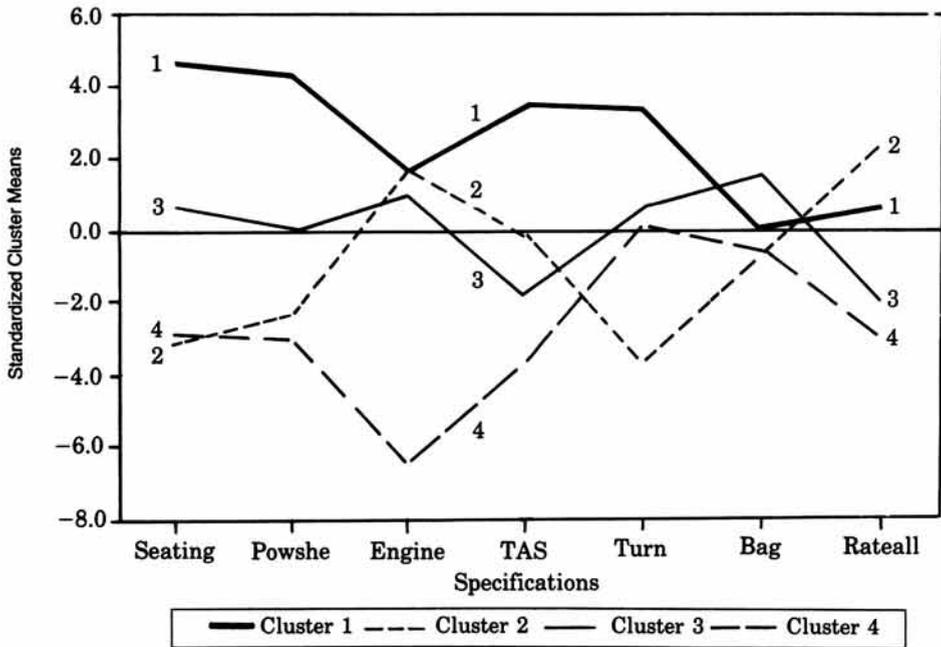
14. Aldenderfer and Blashfield [1984].

15. Additional figures and tables are available upon request from the authors.

Table 1
Summary Statistics
— by Cluster —

	Variable	Label	N	Mean	Standard Deviation	Minimum Value	Maximum Value
Cluster =1	SEATING	Seating (Crew + Passengers)	18	48.61	8.96	33.0	70.0
	POWSHE	Engine power output	18	2025.77	717.87	1120.0	4500.0
	ENGINE	Dummy for engine type	18	1.00	0.00	1.0	1.0
	TAS	True airspeed	18	263.94	26.54	224.0	306.0
	TURN	Turn radius	18	60.59	7.17	49.0	76.0
	BAG	Baggage volume per passenger	18	6.73	1.31	4.8	10.3
	RATEALL	Max climb all engs (fpm)	18	1687.88	402.60	1220.0	2860.0
Cluster =2	SEATING	Seating (Crew + Passengers)	19	19.00	5.61	10.0	33.0
	POWSHE	Engine power output	19	767.42	223.73	420.0	1156.0
	ENGINE	Dummy for engine type	19	1.00	0.00	1.0	1.0
	TAS	True airspeed	19	222.31	39.13	150.0	293.0
	TURN	Turn radius	19	40.43	8.03	25.3	54.0
	BAG	Baggage volume per passenger	19	6.48	1.99	4.0	9.8
	RATEALL	Max climb all engs (fpm)	19	1882.57	400.28	1070.0	2540.0
Cluster =3	SEATING	Seating (Crew + Passengers)	6	34.83	8.54	21.0	45.0
	POWSHE	Engine power output	6	1204.33	291.70	750.0	1424.0
	ENGINE	Dummy for engine type	6	1.00	0.00	1.0	1.0
	TAS	True Airspeed	6	187.33	25.48	143.0	214.0
	TURN	Turn radius	6	53.58	2.51	49.2	56.8
	BAG	Baggage volume per passenger	6	7.91	0.72	6.9	8.8
	RATEALL	Max climb all engs (fpm)	6	1232.00	403.57	930.0	2000.0
Cluster =4	SEATING	Seating (Crew + Passengers)	7	12.42	3.82	10.0	18.0
	POWSHE	Engine power output	7	313.57	45.70	260.0	375.0
	ENGINE	Dummy for engine type	7	0.00	0.00	0.0	0.0
	TAS	True airspeed	7	158.00	14.08	137.0	174.0
	TURN	Turn radius	7	51.35	14.41	31.0	70.0
	BAG	Baggage volume per passenger	7	6.37	3.02	2.9	10.8
	RATEALL	Max climb all engs (fpm)	7	1088.57	228.12	835.0	1390.0

Figure 1
Average Profiles



between cluster 3 and 4 while cluster 1 (2) contains large (smaller) aircraft that exhibit less (more) ground maneuverability. Cluster definition with respect to baggage capacity on a per passenger basis is not a distinguishing feature as little variation exists between groupings. Rate of climb performance indicated similarities between clusters 1 and 2 and between 3 and 4.¹⁶

The group of aircraft in Cluster 2 (this group includes smaller and less powerful planes) is consistent with the ITC findings in the Fairchild Swearingen case. However, there are several other airplanes, albeit smaller in seating capacity, which fall in the cluster with the Metro III (Fairchild Swearingen) and the C99 (Beech); the two models identified by the ITC as constituting the domestic industry. The Metro II (Fairchild Swearingen), the Beech 1900, the CATPASS 200-15, the Cessna Caravan II and the Piper T1040 may each be interchangeable with the Metro III and the C99 in some applications, according to the characteristics data.

Cluster 1, which contains faster and larger capacity aircraft, shows the set

16. Analysis of principal components corroborates the cluster results.

of potential competitors with the ATR-42, the allegedly subsidized import in the CAC case (the CAC-100 was never produced). Three domestic models compete with the ATR-42: two models from Gulfstream AM, the Gulfstream I-C, and the G-IC G-159C, and one model by Allison, the Super 580 CV 580 A. Any injury by reason of subsidized imports to the firms producing these models would then appropriately have entered the respective injury calculations.

VI. Final Comments

In this paper we have presented an alternative to the present definition of *like product* based on multivariate statistical analysis. To illustrate our method, we analyzed two countervailing duty cases brought against imports by the U.S. commuter aircraft industry. We believe that the ITC *like product* definition which was used in these cases may have been too narrow. In the CAC case, there were no other models produced by domestic firms which, according to the ITC, fell in the same category as the ATR-42 (and thus the CAC-100). The relatively early stage of development of the aircraft, as evidenced by what the ITC found to be inadequate sales effort, was the primary reason for the finding of no injury by reason of subsidized imports. Our analysis suggests, however, that three additional domestic models could have been considered to be similar to the ATR-42. In the Fairchild Swearingen case, five additional models, produced by three additional domestic firms, might reasonably have been included in the definition of domestic industry.

ITC decisions defining *like product*, and thus the scope of the LTFV investigation, are crucial in the determination of injury in the domestic industry. Based on the analysis presented here, we concur with the suggestion of several commentators that a revision of current practice is necessary and that a broader definition may often be more appropriate. The immediate consequence of applying the method suggested here is that the financial health of more firms will be examined before an injury determination is made. The more domestic firms considered, the less likely is the ITC to find injury by reason of dumped or subsidized imports, making tariffs a less frequent outcome. From a social welfare point of view, it is perhaps desirable to view

competition from an industry wide perspective rather than from the viewpoint of one or several firms.

The antisubsidy cases brought by CAC and Fairchild Swearingen were terminated by a finding of no injury by reason of subsidized imports. However, the role of the *like product*, and thus the relevant domestic industry, played a critical role in these determinations. The cluster analysis results for these particular cases support the general supposition of practitioners (and the specific dissent of an ITC Commissioner in the Fairchild case) that ITC practice may often lead to a definition of *like product* which is too narrow.

Cluster analysis or other classification-based systems may present useful techniques for identifying the appropriate relevant market in investigations involving products with observable, measurable, linearly-independent characteristics. To the extent that goods traded between major trading partners consist increasingly of high-tech products which are produced on increasingly flexible assembly processes, such analysis will become increasingly important in making administered protection decisions.

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