

CROSS ELASTICITY OF SUPPLY: SELDOM HEARD OF AND SELDOM TAUGHT

Anthony J. Greco*

Abstract

This paper focuses on the cross elasticity of supply concept and incidentally on the cross elasticity of demand concept. The author reviews a body of contemporaneous and older textbooks in intermediate microeconomics and industrial organization/public policy and finds that cross elasticity of supply is and has been seldom discussed in such textbooks, while cross elasticity of demand tends to be discussed much more frequently. The author summarizes the discussion afforded to both cross elasticity of demand and cross elasticity of supply in intermediate microeconomics and industrial organization texts, pointing out the difficulties and limitations relative to these concepts in an attempt to ascertain why so much more coverage is given to cross elasticity of demand. Although some plausible explanations for the neglect of cross elasticity of supply are uncovered, future research may offer additional explanations.

Introduction

Nearly all students enrolled in intermediate microeconomics classes and many enrolled in principles of microeconomics classes are exposed to the concept of the cross elasticity of demand. They learn that the coefficient of the cross elasticity of demand is equal to the percentage change in quantity demanded of one good divided by the percentage change in the price of another good. That is, they learn that the coefficient of cross elasticity of demand measures the response in the quantity demanded of one good to a change in the price of a different good. They learn further that the sign of this coefficient indicates a certain possible relationship between these two goods, a positive coefficient suggesting a substitute relationship and a negative coefficient a complementary relationship. The establishment of a substitute relationship in this manner can be helpful, students are taught, in the delineation of a market—that is, in the identification of firms that are competitive sellers within a given market.

However, not all of the above students will necessarily be exposed to the concept of cross elasticity of supply. While the aforementioned cross elasticity of demand concept measures substitutability or interchangeability through the eyes of consumers or purchasers, the cross elasticity of supply measures the same through the eyes of producers or suppliers. Here again, the sign of the derived coefficient of cross elasticity of supply, found by dividing the percentage change in quantity supplied of one good by the percentage change in the price of a different good, is suggestive of a given type of relationship between the two goods in question. However, the respective signs of the coefficient of cross elasticity of supply are interpreted exactly the opposite as are the signs of the coefficients of cross elasticity of demand. Specifically, a positive coefficient of elasticity of supply suggests that the two goods are complementary in supply—that is, through the eyes of the suppliers of the two distinct goods. On the other hand, a negative coefficient of elasticity of supply suggests a substitute relationship between the two goods in the eyes of the suppliers of these two goods. The establishment here of a substitute relationship again can be helpful in the delineation of the true sellers within a given market.

* Anthony J. Greco, Department of Economics and Finance, University of Louisiana – Lafayette, Lafayette, Louisiana 70504-4570, ajg1979@louisiana.edu.

In fact, exclusive reliance on the cross elasticity of demand coefficient to the exclusion of the cross elasticity of supply coefficient may result in an improper delineation of the relevant product market. For example, one would not be inclined to include producers of right-handed baseball gloves and producers of left-handed baseball gloves in the same industry on the basis of the cross elasticity of demand coefficient. Clearly, buyers of these two types of gloves would not consider the gloves to be interchangeable in use. However, respective suppliers of these different types of gloves may consider themselves to be in the same industry because they could easily shift resources away from the production of their type of glove toward the production of their rivals' type of glove in response to an increase in the price of the latter type of glove. The coefficient of cross elasticity of supply, of course, addresses this issue of producer substitutability and, hence, makes the delineation of markets a somewhat more accurate process.

Yet, as mentioned above, many undergraduate students of economics are unaware of the cross elasticity of supply concept simply because it is not being taught to them. Further, it is hardly ever mentioned in current industrial organization and public policy texts or in intermediate microeconomics texts. Perhaps this is true because authors of such texts believe that their readers can infer the concept of cross elasticity of supply from the authors' discussion of cross elasticity of demand. That is, perhaps the authors are trying to "economize" on space within their texts. This seems rather unlikely since most of these same authors do not even mention the cross elasticity of supply concept in even as much as a footnote. This would lead one to believe that authors of these texts omit a discussion of the cross elasticity of supply either because they feel that the concept is totally irrelevant or because they have never been exposed to it themselves.

In all likelihood, the former of these two alternatives applies. Granted that the whole idea of elasticity in economics is, well, a rather "elastic" or flexible concept in and of itself, capable of being applied to a whole host of pairs of related variables, the cross elasticity of supply would seem to be one of the most useful and conventional of such elasticity concepts, one that at least is worthy of mention in an industrial organization or intermediate microeconomics text. It has, after all, been used rather extensively, although not consistently, by the courts and antitrust agencies as one of the criteria on which to delineate appropriate product markets in the application of antitrust law. More will be said of this subsequently. This article reviews the exposure given to the concept of cross elasticity of supply in industrial organization and intermediate microeconomics texts, as well in other academic discussion, over an extended period of time. Further, the paper briefly alludes to the use of the concept of cross elasticity of supply in the application of antitrust law by the courts and the antitrust agencies over the years in an attempt to understand the seemingly general neglect of this concept.

Review of Current Textbooks

In an attempt to determine the extent of exposure given by current upper-level economic textbooks to the concept of cross elasticity of supply, the author examined 13 contemporary intermediate microeconomics texts and 17 older intermediate microeconomics texts as well as three contemporaneous and 18 older industrial organization/governmental policy textbooks. Although this grouping of textbooks does not represent the totality of texts of these types, the author did make an attempt to examine all such texts by contacting all publishers of economics textbooks through phone calls or direct mail or by checking appropriate websites. The number of books actually examined by the author, though not definitive, is, he feels, adequately representative of the treatment accorded the cross elasticity of supply concept in upper-level economic textbooks. A listing of all the texts reviewed can be obtained from the author.

As the reader is, no doubt, aware, the number of intermediate microeconomics texts examined exceeds that of the industrial organization texts because more of the former have been written. The

contemporary intermediate micro texts reviewed were published between 1995 and 2004. None of these texts addressed the cross elasticity of supply concept. Ten of these same texts did, however, discuss the cross elasticity of demand concept, and three did not discuss either of these cross elasticity concepts. The older intermediate micro texts reviewed dated from 1949 to 1994. Only one of these texts, *Economic Analysis, Vol. 1 – Microeconomics*, Fourth Edition, by Kenneth E. Boulding, discussed cross elasticity of supply. Thirteen of the older texts, including Boulding's, discussed cross elasticity of demand, and two did not discuss either cross elasticity concept. Hence, only one of 30 intermediate microeconomics texts discussed cross elasticity of supply, and that one was published in 1966.

The three contemporary industrial organization texts ranged from 1997 to 2002 in publication dates. Of these, only one, *The Economics of Industrial Organization*, Fourth Edition, by William Shepherd, discussed the cross elasticity of supply as well as the cross elasticity of demand concepts. The remaining two texts discussed only the latter of these concepts. Of the 18 older industrial organization texts, which were published from 1968 to 1992, 11 discussed the cross elasticity of demand concept only, five discussed both cross elasticity of demand and supply, and two did not discuss either cross elasticity concept. Therefore, only six of the 21 industrial organization texts discussed cross elasticity of supply, none after 1997. In all, only one of the 16 contemporaneous texts and six of the 35 older texts reviewed discussed cross elasticity of supply; that is, only seven of the 51 total texts reviewed dealt with this topic. In contrast, 43 of the 51 texts reviewed did discuss cross elasticity of demand, and seven of the 51 did not discuss either cross elasticity concept.

Cross Elasticities in the Literature and in the Courts

Cross elasticity concepts have been the focus of at least two essentially unrelated streams of research in economic literature. The first of these centered exclusively on the use of cross elasticities of demand to define various types of market structure from competition to monopoly as well as the various forms of imperfect competition. This stream of research apparently originated in the 1930s and is quite voluminous.¹ The second stream of economic thought involving cross elasticities deals with the use of such concepts in the delineation of a given product market. This stream of thought apparently originated with the articulation of the cross elasticity of demand concept as a test for market delineation by Bain, as well as Machlup, in 1952 (Bain 1952; Machlup 1952). However, Gregory Werden has contended that the basic idea of cross elasticity of demand had been conceived before its use as a test market delineation by either Bain or Machlup (Werden 1992). Coincident with his work and that of Bain relative to the use of the cross elasticity of demand as a market delineating factor, Machlup introduced the cross elasticity of supply in 1952 as an additional factor in the delineation of market boundaries. Soon after their introduction by Bain and Machlup in the economic literature as indicators of market boundaries, the cross elasticities of demand and supply came to be mentioned and considered as market delineating factors in antitrust cases by the U.S. Supreme Court and other courts.

In fact, the first mention of cross elasticity of demand relative to market delineation in a reported federal antitrust case was in the Supreme Court's opinion in *Times-Picayune* in 1953 (*Times-Picayune v. U.S.*, 1953). In its decision, the Supreme Court for the first time offered some principles of market delineation. In a relatively terse statement, the Court noted that close substitutes should be identified through the use of cross elasticities of demand and that markets

¹ As suggested by Koch in his text, *Industrial Organization and Prices*, Second Edition, the reader may minimize his/her effort in reviewing this literature by referring to Mancur Olson and David McFarland, "The Restoration of Pure Monopoly and the Concept of the Industry," *Quarterly Journal of Economics* 76 (November 1962), 613-631.

should be narrowly delineated (*Times-Picayune v. U.S.*, 1953). Since then, the Supreme Court has acknowledged the use of cross elasticity of demand in a number of other cases.² Actually, the Supreme Court recognized the substance of the cross elasticity of supply prior to *Times-Picayune*. Although the Court did not use the term cross elasticity of supply as such in the *United States v. Columbia Steel Co.* decision of 1948, it did rely on the idea of supply substitutability in ruling that the proper product market in this case was all rolled steel products (plates, shapes, sheets, bars, and other unfinished steel products) as opposed to only plates or shapes (*United States v. Columbia Steel*, 1948). However, the only other acknowledgment of supply substitutability by the Supreme Court was found in a footnote in its *Brown Shoe Co. v. United States* decision of 1962 (*Brown Shoe v. U.S.*, 1962). Nevertheless, the concept of supply substitutability, and specifically the cross elasticity of supply, has been acknowledged in a larger number of Federal District Court and Appeals Court decisions over the years. In fact, since 1975 there has been a discernibly greater acceptance of supply substitutability as a standard for market delineation in at least the Federal Appeals Courts. Further, cross elasticity of supply, along with the cross elasticity of demand, continues to be discussed in scholarly legal literature to the present.³ That is, it remains a relevant concept in the consideration of market delineation criteria. Despite this, cross elasticity of supply, as noted above, remains largely ignored or, at least, emphasized to a much lesser degree than cross elasticity of demand as a topic of discussion in intermediate microeconomics and industrial organization and policy textbooks. Again many students in such courses are never introduced to the concept of cross elasticity of supply. The question is, why is this concept so routinely ignored?

As one would suspect, cross elasticity concepts are not without certain theoretical and practical difficulties. To begin, as Needham pointed out long ago, products can be defined as substitutes or complements, either in demand or in supply, only after empirical information has been gathered concerning the responses of quantities demanded or supplied to changes in the prices of other products. Further, the “all other things remaining the same” assumption must be applied to cross elasticities of demand or supply. That is, there can be no change in the prices or in the nonprice variables, such as advertising expenditures of firms, in response to changes in the prices of the other products. Obviously, all other things cannot be held constant in reality, and this forces economists to employ statistical techniques to measure cross elasticity relationships. Such techniques, of course, can only yield estimates of a probabilistic nature (Needham 1969; Shepherd 1997; Stocking 1957).

Further, even if the requisite empirical information could be obtained to allow the calculation of precise cross elasticities of demand and/or supply and if these elasticities were ranked, the larger values of which would indicate closer substitute relationships between any two goods, a crucial problem remains. That is, where would one draw the line between successive cross elasticity values to determine which pairs of goods are viewed as the same (and hence in the same industry) and which pairs of goods are to be considered different (and hence not in the same industry)? For example, as indicated previously, a negative coefficient of cross elasticity of supply suggests a substitutable or interchangeable relationship between two goods. However, the question remains as to what level of negativity the coefficient of cross elasticity of supply between two goods must achieve to justify classifying them as both being in the same industry (Clarkson and Miller 1982; Needham 1969). In addition, Shepherd has pointed out that responsiveness exists in a

² See, for example, *U.S. v. du Pont (Cellophane)*, 351 U.S. (1956); *U.S. v. General Dynamics Corp.*, 415 U.S. (1974); and *Eastman Kodak Co. v. Image Technical Services*, 504 U.S. (1992).

³ See, for example, Irston R. Barnes, “Markets, Competition, and Monopolistic Tendencies in Merger Cases,” *Marquette Law Review* 40 (1956); Mark S. Massel, *Competition and Monopoly: Legal and Economic Issues* (1962); Robert Pitofsky, “New Definitions of Relevant Market and the Assault on Antitrust,” *Columbia Law Review* 90 (1990); and Gregory J. Werden, “The History of Antitrust Market Delineation,” *Marquette Law Review* 76 (1992).

time dimension and that the shorter the period of time examined, the smaller the responsiveness will be. Also, while the time period chosen is important, it is usually arbitrary (Shepherd 1997). Given these difficulties in measuring and interpreting cross elasticity coefficients, can one conclude that the whole idea of substitutability is an inferior device in attempting to define industry boundaries, one that should be abandoned in favor of other criteria, such as similarity of physical characteristics? Needham concluded in the negative after reflecting on why substitutability is stressed in economics. As we know, economic theory is concerned with the behavior of firms as individual decision-making entities. Such behavior, however, is influenced by, among other things, which firms a firm considers in making its decisions. Although all firms may be affected by the actions of others, any one firm will focus only on those other firms that significantly influence their decision making (Needham 1969). The use of cross elasticity coefficients is a way of discerning the extent to which firms are influenced by the pricing decisions of other firms (Clarkson and Miller 1982). Despite this, it has been pointed out that the identification of high cross elasticity coefficients does not reveal anything relative to how a firm will react to another firm's changes in quality, advertising, service, warranty, and other factors that might be considered of importance by potential customers. That is, selling price is not the only relevant variable considered by such customers. Therefore, cross elasticity coefficients, in their implicit neglect of nonprice competitive factors that are nonconstant and used to various degrees by firms, view competition as one-dimensional. In this light, cross elasticity coefficients cannot be viewed as singular and definitive indicators with which to delineate product markets (Armentano 1990; Bishop 1961).

Nevertheless, cross elasticity coefficients are, as noted above, somewhat helpful in the market delineation process and continue to be used in the courts as viable tools in this process. Yet, as noted above, cross elasticity of supply, in particular, is still largely ignored in intermediate microeconomics and industrial organization/public policy texts. This may seem somewhat puzzling since the aforementioned limitations of cross elasticity apply at least as much, if not more, to cross elasticity of demand as they do to cross elasticity of supply. Machlup himself may have provided a reasonable explanation for the relative neglect of the cross elasticity of supply in the aforementioned textbooks. Specifically, Machlup suggested that the simultaneous consideration of cross elasticities of demand and supply created a larger perception of the industry than one would like to consider. Therefore, Machlup suggested that it would be preferable to focus on either demand relationships or cost (supply) relationships than to intertwine them even though the industry groups delineated through the use of each separate relationship would differ from each other. Since he chose to deal more with the sales aspect than with the cost aspect of production in his own immediate discussion, he confined himself therein to product (demand) relationships (Machlup 1952).

Nearly a half-century later, Shepherd notes that some analysts were attributing a major role to cross supply elasticity of supply in the market delineation process. He noted that such analysts were considering various firms outside a specific market as "uncommitted entrants," basically viewing these firms as somehow already part of the market under consideration. He cast discredit on such a view by noting that supply conditions deal with entry into the market and that it is confusing to mix the definition of the market with the possible entry of other firms into such a market (Shepherd 1997). He asserted that it was logical to define the market initially on the basis of consumer choice (demand) after which relevant entry conditions could be considered. Despite the fact that production facilities can often be shifted quickly and efficiently from one product to another, he insists that such potential entry should not be equated with current market participation (Shepherd 1997).

The aforementioned, then, may provide plausible explanations for the preference of the economics texts for discussing cross elasticity of demand over cross elasticity of supply.

Alternately, this preference may simply, as suggested earlier, be due to the intention of these texts' authors to economize on their discussion of cross elasticity of supply. Or it may be due, as also suggested above, to these authors' unawareness of the concept or role of cross elasticity of supply. It still seems to this author, however, that this latter explanation is rather unlikely. Therefore, in light of the role the cross elasticity of supply continues to play in the market delineation process in the courts, it would seem that this concept warrants more discussion than it has traditionally received in the textbook literature. Perhaps further research will suggest other reasons as to why the cross elasticity of supply concept has continued to be so neglected in that literature.

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