Shipping the Good Apples Out: Some Ambiguities in the Interpretation of "Fixed Charge"

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In a recent article titled "Shipping the Good Apples Out: The Alchian and Allen Theorem Reconsidered," Thomas Borcherding and Eugene Silberberg reformulated a hypothesis first proposed by Alchian and Allen 14 years ago (Borcherding and Silberberg 1978). The original theorem suggested that a fixed charge T (such as a transportation charge), when applied equally to two similar goods (high- and low-quality apples), would lead, through the law of demand, to a relative increase in the consumption of the high-quality good as compared with the lower quality (Alchian and Allen 1964, pp. 74–75). Four years later, Gould and Segall demonstrated that adverse substitution effects with some third good, even holding income constant, could reverse the implied ratio change and lead to a relative increase in the consumption of the lower-quality good (Gould and Segall 1969).

In their reformulation, Borcherding and Silberberg attempted to do two things. They showed that by adding an additional constraint (Hicks's third law) the Alchian and Allen theorem will hold under conditions where the two goods are close substitutes. They then proceeded to show the remarkable generality of the theorem by deriving several empirically refutable implications. These included the following: (1) more high-quality meat (relative to low quality) will be consumed in restaurants than at home; (2) relatively more high-quality fabric will be used on finely tailored suits than on less tailored suits; (3) relatively more nice homes will be built on expensive land than on inexpensive land.

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The purpose of this paper is twofold. First, I will show that none of the implications suggested by Borcherding and Silberberg follow from their mathematical model because they violated a subtle but basic assumption in their theory. Second, I will reformulate the original Alchian and Allen theorem in such a way that mistakes in its application are less likely to be made and the implications are far more general. An interesting by-product of this reformulation is that it suggests that Alchian and Allen were correct—their theorem does follow from just the law of demand. This finding is in direct contradiction to Gould and Segall and Borcherding and Silberberg.

The Problem

Using their restaurant example, because it is simple and contains the error common to all of their proposed tests, the Borcherding-Silberberg argument can be restated as follows.

Suppose a consumer can purchase meat in two grades at the local grocery store. Good quality (X_1) sells for \$2.00 per pound while poor quality (X_2) sells for \$1.00 per pound. At these prices, consumers prefer to buy some of both grades, in the ratio X_1/X_2, for home consumption. Assume further that there is a restaurant which serves both grades of meat. Their prices, as listed on the menu, have been increased by some common amount, T, which covers the costs of "cooks, waiters, fancy decor, etc." If T is equal to \$5.00, the price of X_1 relative to X_2 will have fallen from 2/1 to 7/6. Because it has been assumed that good- and poor-quality meats are close substitutes, differential trade-off effects with some third good will be trivial, and the ratio of X_1/X_2 consumed in the restaurant will be greater than the ratio consumed at home. *In other words, people who eat in restaurants will consume relatively more good meat than poor meat as compared with people who eat at home.*

To see why this implication does not follow from their theory, imagine that the restaurant owners price explicitly every good and service which they provide. When a customer enters the restaurant, a clock starts measuring the number of minutes he consumes floor space. The waitress charges by the minute and by the service provided; a smile costs extra. The cook charges for time, the oven is metered for kilowatt hours, and the dishwasher is paid by the dish. On the menu, good meat is priced at \$2.00 per pound and poor meat at \$1.00 per pound. To simplify further, assume that the restaurant has no comparative advantage over the homeowner in the production of dining services. Then the rent per square-foot-minute at the restaurant is exactly equal to the rent at home. Similarly, waitressing prices, cooking prices, etc., are equal to their domestic counterparts.

Under these conditions there is no reason to suppose that relatively more good meat will be consumed at the restaurant because there has been no change in their relative prices. The reason for this should now be quite obvious: there is in fact no "fixed charge" operating to alter the relative price of good and poor meat.

Let us now alter the assumptions one at a time and see how this affects the outcome. Suppose that the suppliers of restaurant services have a comparative advantage in the production of at least one of their services. For example, assume the explicit price for waitressing is less per minute than the cost at home. If other prices remain unchanged, customers will consume more waitress service at the restaurant than they would at home, as implied by the law of demand. This, however, will not alter the ratio of good to poor meat consumed because, by assumption, grades of meat are such close substitutes that their cross-elasticities with other goods approach equality. In other words, if the customer consumes more waitress services at a lower price, he may increase or decrease his consumption of meat (depending upon whether meats are complements to or substitutes for waitress service), but the change in the amounts of good and poor meat will be equal and the *ratio* of their consumption will remain unchanged.

Next assume that the restaurant owners do not explicitly price all economic margins. Instead, they lump all service costs together and add the average cost per customer to the prices of meat on the menu. If this charge is $5.00, as in our previous example, this will raise the price of good meat from $2.00 to $7.00 and the price of poor meat from $1.00 to $6.00. It would now appear that to a customer of the restaurant the relative price of good meat has fallen compared with poor meat, thereby inducing him to consume relatively more good meat. This is false. *The lumping together of all service costs into the price of meat has created the illusion of a fixed charge and a change in the relative prices of various grades of meat. In fact, there has been no fixed charge, only a price for additional restaurant services, the consumption of which, by assumption, has no effect on the ratios of good to poor meat consumed.*[1]

The Borcherding-Silberberg restaurant example went wrong because the apparent fixed charge was in fact no fixed charge at all but merely a price for another good. But why then does their transportation-cost example predict that relatively more good apples will be shipped out? Is it not true that transportation is an economic

[1] The lumping together of all service costs into the price of meat has the effect of reducing to zero the marginal cost to the customer of extra restaurant services. This will induce him to consume more of these unpriced goods. However, because the various grades of meat are close substitutes, this should not affect the ratio of meat consumption.

good? How are transportation costs different from restaurant costs? The answer to these questions can be found within the structure of the theory itself.

The role of assumptions in a theory has long been debated, at least among economists. Of course, one role they serve is to provide a beginning or a starting point from which the theory develops. Another role they serve is to provide constraints such that the possible theoretical outcomes are limited to a finite number or, better still, to one. This allows the hypotheses to be potentially refuted. One often overlooked role of assumptions is to define the set of conditions under which the theory can be expected to predict. The Alchian and Allen theorem, as restated by Borcherding and Silberberg, places some very interesting restrictions on the fixed charge T. First, the charge is an essential condition for obtaining access to both grades of the product in question. This condition is satisfied in both the apples and restaurant examples. It is impossible for an Indiana resident to consume Washington apples without paying the transportation charge. Similarly, it is impossible to eat meat in a restaurant without paying some service charge. A careful examination of the theory reveals another restriction on T. Notice that T, the charge for transporting apples, is not considered in their theory to be an economic good. Only X_1, X_2, and X_3 are considered to be economic goods. Borcherding and Silberberg explicitly note that "the Alchian and Allen proposition assumes that nothing happens to the goods themselves as a result of the price changes." In other words, T has no value of its own. It is here that the transportation charge differs from the restaurant service charge because, in some sense, transportation is not an economic good. Consider the following possibility: suppose that an Indiana resident was given his choice of a good (or bad) apple shipped from Washington or an identical apple that had been grown in Indiana. If the prices were the same, he would be indifferent. If the Washington apples were priced higher to cover the transportation costs, they would never be chosen over homegrown. In and of itself, the transportation of apples is not an economic good. It would never be purchased for its own sake. Now consider an individual confronted with the choice of meat at home or meat in the restaurant. At the same price he would not necessarily be indifferent because a nice, air-conditioned restaurant with a friendly waitress serving the food, a cook preparing the food, and a dishwasher to clean up afterward all have a value of their own. Charges for this type of service are different from the hypothesized fixed charge and so violate the assumed theoretical conditions. The Borcherding-Silberberg claim that "the analysis applies when *any kind of cost item* is added equally to similar goods" is false and leads them to erroneous conclusions. This same error occurs throughout their analysis, including their examples of tailoring and house quality.

It might appear that after careful consideration the theoretical constraints on the Alchian and Allen theorem are so restrictive as to render it empirically empty, with the exception of transportation charges and per unit taxes. In the classical world of the economist, where is one to find a charge for something which is not an economic good? Such an occurrence would be logically impossible, since no one would ever pay a price greater than zero for a thing with no value. However, as I will show in the next section, by carefully reformulating the hypothesis it is possible to derive numerous cases where it has some predictive content. I will also demonstrate that Alchian and Allen were correct. The implication that a fixed transportation charge will induce customers to purchase relatively more high-quality apples follows directly from the law of demand.

A Reformulation

Consider an individual with a demand curve for apple juice as illustrated in figure 1. This curve, which is linear simply to facilitate exposition, is drawn under the assumption that real income is held constant: it is a compensated-demand curve. Furthermore, to the usual variables held constant, I shall add the assumption that the quantity which this individual purchases each time period is inversely related to the quantities which he expects to purchase in the following time periods.

Next, consider an individual producer and seller of apple juice. Assume that his marginal cost for producing a unit of juice is constant

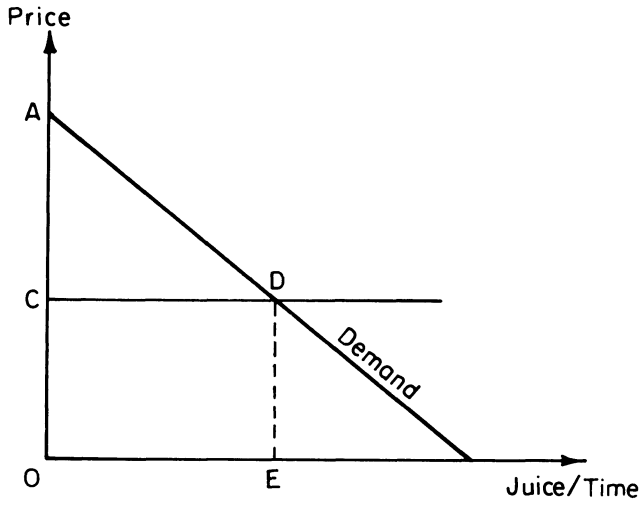

FIG. 1

at *OC* and all the costs of transacting are zero. With the assumption of wealth maximization, we can conclude that in this time period *OE* units of juice will be exchanged between buyer and seller at a marginal price equal to *OC*. However, unless additional constraints are placed upon the model, it is impossible to predict what "the price" will be. For example, the seller could charge one price of *OC* and allow the buyer to purchase all that he wants. He could charge *OA* for the first unit, less for the second, and so on down the demand curve until the last unit sells for *OC*. Alternatively, the seller could charge one price equal to the average of all the incremental prices and require the buyer to purchase *OE* units on an all-or-nothing basis.

While there are an infinite number of possible pricing schemes, only one is of interest here: the seller charges up to *ADC* for the *right to purchase juice* and then charges one price, *OC*, per unit. In other words, *every time the buyer wishes to purchase apple juice he is charged a fee just for the right to buy.* This fee could be likened to an admission fee that must be paid before juice can be bought at the price of *OC*. If we were to consider only one time period, the buyer would still purchase *OE* units, because this pricing scheme merely extracts his consumer surplus. Our demand curve is compensated for income effects thus, there is no shift in the curve, and the same marginal conditions prevail as before.

However, as soon as we consider more than one time period the situation changes. The admission fee is a price which the buyer must pay each time he wants to purchase apple juice. In order to minimize this cost, the wealth-maximizing consumer will reduce the number of times he buys juice and buy more juice each time. To see this, suppose that initially there is no admission fee, only one price, *OC*, for each unit of juice. Our consumer will purchase *OE* units each time period. Now the seller imposes some admission fee less than or equal to *ADC*. Given only one time period, the individual would buy *OE* units for the reasons explained before. But now, with more than one time period, there exists the possibility of intertemporal substitution. To avoid or minimize the admission fees, the buyer decides not to purchase juice as often.[2] This, by assumption, will shift the current demand curve outward, and he will buy more juice each time he shops.

Numerous empirical tests of this theorem exist. For example, most states have tax-supported universities which charge some fixed fee or tuition for the right to take courses. Unless the student pays this

[2] I am not offering here a theory to explain the timing of purchases by the consumer. How often he chooses to buy juice may be a function of the size of his refrigerator, the size of his appetite for juice, or the distance between his home and the juice store. Regardless of his reasons, I am assuming only that he obeys the law of demand. As the price of buying "frequency" increases, he will have incentive to buy less often.

tuition he may not take courses, but without the courses the tuition has no value. Tuition corresponds to the charge for the right to buy courses or the admission fee, while courses correspond to juice. If the state now raises tuition fees without changing the price of additional courses, students who continue to go to school will take more courses per semester. Similarly, if municipalities raise the greens fees on public golf courses, and if these fees are independent of the number of holes played, those golfers who continue to play will play less frequently but will play more holes each time out.

Before going any further, let us compare this simple model with the Borcherding-Silberberg formulation of the original Alchian and Allen theorem. Suppose we have two apples both of which contain the economic characteristic, juice. One has two times more juice than the other and is considered to be the higher-quality apple. The juice is held inside a container (the apple peel) which has no value of its own separate from the fact that it contains the juice. However, in order to buy the juice the container must be purchased. So far, I believe this to be consistent with the Borcherding-Silberberg notion of quality. Assume that the juice sells for a constant price of 10¢ per unit, and in the state of Washington there is no charge for the container. Thus, the high-quality apple, which contains two units of juice, sells for 20¢ while the inferior apple, containing only one unit, sells for 10¢. Now the apples are shipped out to Indiana at a cost of 5¢ per apple (container), regardless of how much juice they contain. Indiana consumers, wishing to purchase these Washington apples, must pay an extra 5¢ each time they buy an apple because the apples now sell for 25¢ and 15¢, respectively. The 5¢ per apple "admission fee" fits the requirements on the fixed charge. It is an essential condition for obtaining access to both apples and it has no value of its own. *Notice that the price of juice at the margin has not changed, it is still 10¢ for the extra unit. Only the admission fee has increased.* Because the marginal price of juice has not changed and we have assumed compensated-demand curves, those consumers who continue to buy apples will buy the same amount of juice. However, they will buy fewer apples as they attempt to minimize this admission fee. Together, this implies that they will purchase apples with more juice in them: higher-quality apples.

While this reformulation allows us to derive implications similar to those of the original Alchian and Allen theorem, it avoids the problems raised by Gould and Segall and eliminates the need to introduce the additional constraint of Hicks's third law as suggested by Borcherding and Silberberg. This follows from the fact that only one price has actually changed—the price of admission to the apple juice. Therefore, each individual who has a consumer surplus greater than the admission fee will continue to purchase apple juice, only now he

will buy it in larger containers. To see why substitution effects with some third good cannot destroy this implication, consider the following. Those individuals that find the admission fee greater than their consumer surplus will purchase no juice. As a result, the market demand for juice substitutes will increase, their prices will rise, and the demands for apple juice from those who continue to buy it will shift outward reinforcing the predicted effect.[3] Similarly, the individuals who switch out of apple juice will reduce their consumption of complementary products, lowering their prices and again shifting outward the demands for apple juice among that group who did not switch. *Thus, the effect of introducing other goods, both substitutes and complements, serves to reinforce the initial implication that those individuals who continue to buy apples will now buy higher quality or apples with more juice.* At least when interpreted in this way, Alchian and Allen were correct when they stated that their theorem followed just from the law of demand.

The reformulated theorem is capable of generating not only the implied effects of a transportation charge but also a per unit tax.[4] For example, if we assume that the tobacco consumer is interested in "smoking minutes" as an economic good, we can conclude that the imposition of a fixed per unit tax on each package (container) of cigarettes will lead to consumers buying more smoking minutes per pack. I suspect that to a great extent it is the increase in taxes per package of cigarettes which has led to the introduction of king-size and super-king-size cigarettes.

Furthermore, if the telephone company increases its charge for installing phones or its monthly fixed charge for local service, fewer people will have phones. But those who do will use them more. Similarly, if the fixed charge for making a local call on a pay telephone is increased, people will make fewer calls but will talk longer per call. And, if the post office raises its rates for first-class mail, letters will be longer and more informative.

If we depart from the traditional economic world of Walrasian auctioneers and introduce positive transaction costs, our model can be further generalized. The transactions costs associated with any given exchange can be broken down into two components: those costs which are independent of the number of units exchanged and those costs which vary directly with the quantity exchanged. If the former are

[3] This ignores the fact that juice prices will initially fall as some buyers purchase less juice and more substitutes. This, however, will reinforce the predicted effect.

[4] For an interesting account of the effects of taxes on the ratios of characteristics found within economic goods, see Barzel (1976). Note that the reason the per unit tax affects the makeup of goods is because it is not a payment for any economic good. In other words, it fits the requirement for a fixed charge.

increased, holding the latter constant, our hypothesis implies that fewer transactions will occur. However, when a transaction does occur, more units will be exchanged. For example, assume that the government passes a law requiring credit institutions to fill out numerous new forms before they can grant a loan. The quantity of these new forms does not depend upon the dollar value (quantity of dollars loaned) of the loan. This additional transaction cost is analogous to an admission fee and will result in fewer but larger loans. Along these same lines, the transaction costs associated with buying candy and popcorn in a theater will be relatively higher if it involves missing part of the movie. This could explain why candy bars are usually bigger at a theater candy stand than at the local food stores where missing the movie is not part of the transaction cost.

Concluding Remarks

Within the original Alchian and Allen theorem and the reformulated version offered by Borcherding and Silberberg there remains one minor problem. It is one thing to show that individuals who continue to buy apples will now buy relatively more of high quality after the imposition of a transportation charge; it is another thing entirely to show that a group of individuals will consume relatively more of high quality. This is because the transportation charge will affect the individuals in one of two different ways. If the charge is less than the consumer surplus the buyer will continue to buy apple juice but will purchase it in larger containers (i.e., higher quality). However, if the charge is greater than the individual's consumer surplus he will stop buying apples completely. It is possible that consumers of high-quality apples actually have a smaller consumer surplus than those consuming apples of low quality. If this is the case, the imposition of a fixed charge could cause enough consumers of high-quality apples to drop out of the market completely, more than offsetting those consumers of low-quality apples who switch to high quality. In terms of the original example, Indiana consumers as a group might purchase fewer high-quality apples (relative to low) than residents in the exporting state of Washington. There is nothing in any of the models to logically preclude this possibility.

Assuming that the interested reader can eliminate the preceding problem by selecting one of an infinitely large number of appropriate assumptions, there still remain the difficulties of testing which arise out of the ambiguity of "quality." Even when the good is relatively simple, there are problems with defining and measuring quality. To illustrate, consider the case of the Washington apple. It consists of a skin or peel and a wide variety of other characteristics such as juice,

sugar, vitamin C, flavor, seeds, and so on. Will the apples shipped to Indiana have more juice, more sugar, or fewer seeds? Which of the characteristics will increase or decrease in quantity? Our theory, in its current form, cannot predict the particular margin of adjustment. However, it can predict one thing which is potentially observable. Take two boxes of apples, one randomly selected from a California market the other randomly selected from an Indiana market, and offer them to consumers of apples at identical prices. They will choose the box of Indiana apples. At the present time, this is the best our theory can do.

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Supplementary Comment by J. S. Mill

Cost of carriage has one effect more. But for it, every commodity would (if trade be supposed free) be either regularly imported or regularly exported. A country would make nothing for itself which it did not also make for other countries. But in consequence of cost of carriage there are many things, especially bulky articles, which every, or almost every country produces within itself. After exporting the things in which it can employ itself most advantageously, and importing those in which it is under the greatest disadvantage, there are many lying between, of which the relative cost of production in that and in other countries differs so little, that the cost of carriage would absorb more than the whole saving in cost of production which would be obtained by importing one and exporting another. This is the case with numerous commodities of common consumption; including the coarser qualities of many articles of food and manufacture, which the finer kinds are the subject of extensive international traffic.

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