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On the Internal Contradictions of the Law of  
One Price

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## Abstract

The “law of one price” defines a market as the geographic area within which the same thing is sold for the same price at the same time, allowance being made for transportation costs. This paper shows that as usually stated the law of one price actually has two plausible interpretations. The law might mean that a market can be defined as the economic space wherein prices differ only by transportation costs. Alternatively, the law might mean that a market, once defined by some other criterion, will exhibit prices differing only by transportation costs. Under the first definition of the law, however, every production site is a market. Under the second definition, prices in fact do not differ by transportation costs. For market definition purposes, the law of one price is therefore either useless or wrong, depending on how it is interpreted.

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## Abstract

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## On the Internal Contradictions of the Law of One Price

*A market, according to the masters, is the area within which the price of a commodity tends to uniformity, allowance being made for transportation costs. That is, two places are in the same market for a good if the prices at the two places differ by transportation costs. (Stigler [1942] 1987, p. 77)*

*Economic terms seem to pass in their historical development through a series of stages which, without pretension to rigidity, may be described as follows: first, no definition is given, but it is assumed that every one has a sufficiently clear idea of the subject to make a formal definition unnecessary; second, a definition is attempted and a number of exceptional forms are noted; third, with the further increase of data, the relative importance of the various forms changes, confusion in discussion is introduced, logomachy takes the place of constructive investigation; fourth, a complete classification of the forms embraced under the original term is made, and problems are investigated with reference to these classes. The bewildering vagueness of economic theory is largely due to the fact that the terms used are in all of these stages of development. (Moore 1906, p. 211)*

### **I. Introduction**

**D**elineating the boundaries of markets engaged economists' attention early on. Many product attributes are important to consumers, but price is the margin on which rivalry is most sharply engaged. Market prices transmit information about changing demand and supply conditions to market participants, and widening price-cost margins signal profit opportunities to which alert entrepreneurs respond. Price consequently has held center stage in economists' attempts to define markets.

Augustin Cournot ([1838] 1927, p. 51), for instance, wrote that a market is "the entire territory of which the parts are so united by the relations of unrestricted commerce that prices take the same level throughout with ease and rapidity." Alfred Marshall ([1890] 1930, p. 325) supplied a similar definition in his celebrated declaration that "the more nearly perfect a market is, the stronger is the tendency for the same price to be paid for the same thing at the same time in all parts of the market...." More recently, Joseph Stiglitz (1993, p. 19) summarized what he

called the “Law of the Single Price,” stating that, “under this law, there is a uniform price in the market, and price differences are quickly eliminated by arbitrage.”<sup>1</sup>

Marshall introduced an important qualification, however, when he observed that, “but of course, if the market is large, allowance must be made for the expense of delivering the goods to different purchasers; each of whom must be supposed to pay in addition to the market price a special charge on account of delivery” (*ibid.*). That qualification subsequently found its way into George Stigler’s price theory textbook, quoted in the epigraph above. Intentionally or not, the law of one price was thereby converted into a law of different prices. Other economists subsequently added transaction costs and information costs to the list of caveats, culminating in a multiplicity of prices nevertheless claimed to be consistent with the law of “one” price.

Economics has few laws. Perhaps the most famous is the (first) law of demand. It truly is a law, because price and quantity demanded are inversely related, *ceteris paribus*, at all times and in all places. But the law of one price as promulgated by the masters is different. It holds – except (more often) when it doesn’t.

The modern empirical literature abounds with apparent violations of the law. Elzinga and Hogarty (1978), for example, report that in 1975 the f.o.b. (“free on board”) price of bituminous coal was \$27.03 per ton in Eastern Kentucky but \$13.75 per ton in Western Kentucky. That same year, the nationwide average charge for shipping a ton of coal via rail was \$5. Inclusive of

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<sup>1</sup> In the same passage, Stiglitz refers to the Law of the Single Price as a “major principle of economics”. Nearly a century ago, Henry Moore listed what William Stanley Jevons called the “law of indifference” – that “there is but one price for commodities of the same quality in the same market” – as one of the hallmarks of (pure) competition. Indeed, Jevons thought they were the same thing: “This law of indifference, in fact, is but another name for the principle of competition which underlies the whole mechanism of society” (quoted in Moore 1906, p. 214). That was Francis Edgeworth’s interpretation as well. He wrote that Jevons’ law of indifference rests on “certain ulterior grounds: namely, certain conditions of a perfect market”, one being that “*monopolies should not exist*” (Edgeworth [1896] 1987, p. 786; emphasis added). Edgeworth specifically ruled out the existence of market “power in virtue of which a proprietor of a theater, in Germany for instance, can make a different charge for the admission of soldiers and civilians, of men and women.” He went on to say in the next sentence that, “the indivisibility of the articles dealt in appears to be another circumstance which may counteract the law of indifference in some kinds of market, *where price is not regulated by the cost of production*” (*ibid.*; emphasis added).

freight charges a ton of comparable coal sold two years later for \$18 in New York, \$38 in New Jersey, \$23 in Illinois and \$34 in Wisconsin. Shrieves (1978) was able to explain less than two-thirds of the observed variation in bituminous coal prices with a model containing 25 independent variables. Baye and Morgan (2001) document sizeable and persistent differences in the prices quoted over the Internet for a seemingly homogeneous product (a zero-point, 30-year, conventional fixed-rate mortgage for a hypothetical New Jersey homebuyer). Asplund and Friberg (2001) likewise find that a given good in a given duty-free shop often sells at different prices when quoted in different currencies, contrary to what the law of one price would have predicted.

This paper argues that the numerous pricing anomalies interpreted by some economists as evidence that the law of one price does not hold – and by others as reason for adding new *ceteris paribus* conditions in order to save the law from accumulating empirical contradiction – reveal two basic problems: the law is internally contradictory, and economists have tended to apply it over-broadly in attempts to force actual markets to conform to abstract models of pure competition. Moreover, stated in its received Marshall-Stigler form wherein transportation cost is the only complication allowed in the market for an otherwise homogeneous good, the very concept of a law of one price is fatally flawed. If the law is incoherent even in this simplest case, it remains incoherent in more complicated situations where additional factors are taken into account. Introducing other complications merely contributes auxiliary reasons why the law fails to hold in the original, transportation-cost-only case.

The next section supplies analytical background by discussing the assumptions under which there is a strong “tendency for the same price to be paid for the same thing at the same time in all parts of the market”. Section III then notes that the law of one price actually has two

plausible interpretations. Does the law mean that a market can be defined endogenously as the territory wherein prices differ only by transportation costs? Or does it mean that a market, once exogenously defined by some other criterion, will exhibit prices that differ only by transportation costs?

Under the first interpretation of the law every production site is a market. Construing the law of one price that way adds more confusion than clarity to the definition of economic markets. Under the second interpretation, the law is simply wrong: prices in fact do not differ by transportation costs. Wherever located, all sellers in a market must charge the same price for the same product. The owners of favorably positioned firms may enjoy Ricardian rents in this case, but they are not thereby able to charge different prices.

It is useful to emphasize at the outset what this paper is *not* about. The paper's connection to the practice of defining markets for antitrust purposes is tangential at best. It is true, of course, that the antitrust laws require enforcers and courts to determine the set of products – and the extent of the geographic area in which the sellers of those products compete – that will be deemed relevant when assessing the impact of mergers and other business practices on economic performance. Depending on how narrowly or broadly a market is defined, a firm does or does not have market power, or a proposed business consolidation does or does not go beyond the market share thresholds that trigger antitrust concerns. Market definition gradually has become an art, if not a science, because of its role in the enforcement of competition law. But the law of one price evolved separately from – indeed, was stated well before – the rise of modern antitrust. Nor is the paper primarily an exercise in the history of economic thought. While the law of one price

surely originated in the work of the “masters,” including Cournot, Jevons and Marshall, it remains a standard part of the canon of price theory today.<sup>2</sup>

In the end, the law of one price has become for modern economists an analogue of the Ptolemaic system of the universe for medieval astronomers. Rather than abandon the notion that the sun moved around the earth, astronomers such as Tycho Brahe invented new and increasingly fabulous theories to account for inconveniently inconsistent observations, in that way hoping to shore up the model of a geocentric universe. All else equal, however, science prefers simpler explanations to complex ones, and in time Ptolemaic notions were abandoned altogether in favor of the Copernican heliocentric model. Increasingly encumbered with addenda and asterisks to make it seem to work, the law of one price, meant originally as a description of the *tendency* for prices in a market to equilibrate, likewise has been rendered worthless. Stripped of interpretative errors and irrelevant complications, the law of one price, properly understood, is seen to be neither more nor less useful than the abstract competitive model on which it was founded, but adding nothing to it.

## **II. The Extent of the Market**

In the textbook model of pure competition, with all its simplifying assumptions (including product homogeneity, perfect information, and perfect resource mobility) all sellers necessarily charge the same price. All production and consumption decisions implicitly take place at a single point in economic space-time. There are no locational advantages or any other differences across

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<sup>2</sup> One of this journal’s referees called the law of one price the “Mother of all Economic Laws.” Nowadays the proposition appears in a number of popular principles of economics texts under the heading of international trade and finance. According to Lipsey, Courant and Ragan (1999, p. 129), for example, “the law of one price states that when a product that can be cheaply transported is traded throughout the entire world, it will tend to have a single worldwide price – the world price.” Similarly, O’Sullivan and Sheffrin (1998, p. G-6) state the law of one price as “the theory that goods easily tradable across countries, should sell at the same price, expressed in a common currency.” Mankiw’s (2004, p. 689) discussion of purchasing power parity likewise is based on the law of one price, which “asserts that a good must sell for the same price in all locations.”

products or firms that matter to buyers and which would cause the demand curves perceived by sellers to slope downward.

But clearly, a useful economic model does not conclude that the products comprising a naturally occurring market must sell at the same price. The goods and services that consumers treat as substitutes frequently are different physically. Even if not, sellers differ as to location, promptness of delivery, their willingness to extend credit, to offer and to honor warranties, to repair or replace defective items, and so on. Buyers likewise differ as to location, willingness to accept delivery, promptness of payment, creditworthiness, penchant for returning items, desire for pre- and post-sale services, and so on. Prices will adjust to reflect differences in the many non-price attributes of transactions and, indeed, as far as competition is concerned, variations in these non-price attributes are substitutes for variations in price (Stigler 1968).<sup>3</sup>

However, as applied to define markets, the law of one price is a simpler proposition. The theory received from those “masters” to whom Stigler refers abstracts from the myriad strategies sellers employ to distinguish their products from those offered by rivals.<sup>4</sup> In eschewing realism for tractability, and by downplaying the dynamic forces that cause prices to be “tossed hither and thither like a shuttlecock, as one side or the other gets the better in the ‘higgling and bargaining’

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<sup>3</sup> Even before Jevons ([1871] 1970, p. 137), economists were aware that price differences for even otherwise identical products can “arise from extraneous circumstances, such as the defective credit of the purchasers, their imperfect knowledge of the market, and so on.” The multidimensional character of competition was in fact recognized as early as 1844 in the writings of the great French engineer-economist Jules Dupuit. See Ekelund (1970) for a summary of Dupuit’s contributions to the analysis of price discrimination and product differentiation. Later, Edward Chamberlain ([1933] 1962), Joan Robinson ([1933] 1969), and Nicholas Kaldor (1934), among others, explored the significance of “gaps in the chain of substitutes” that might be used to identify distinct market boundaries in commonplace situations where, as the last of these masters put it, “different producers are not selling either ‘identical’ or ‘different’ products, but ‘more or less different products’ – the demand confronting them being neither completely sensitive nor completely insensitive to the prices charged by other producers.”

<sup>4</sup> Empirical applications of the law of one price have attempted to grapple with complications like product differentiation by, for example, testing whether the prices of two candidates for inclusion in the same market tend to converge over time (Horowitz 1981) or whether the prices of the candidates are sufficiently correlated to warrant inclusion in the same market (Stigler and Sherwin 1985). An alternative approach that avoids the problem of determining the price at which a heterogeneous good sells is the “shipments test” proposed by Elzinga and Hogarty (1973, 1978).

of the market” (Marshall [1890] 1930, p. 333), the law of one price is a statement about the boundaries of markets wherein products are differentiated along a single dimension, namely the locations of sellers. All other complicating factors possibly influencing prices implicitly are held constant.

In this stylized world of static, long-run competitive equilibrium, two sellers are said to be in the same market if the prices they charge differ only by the cost of transportation between their separate locations. In that world, sellers quote prices f.o.b.: the price paid by any buyer is equal to the price at the seller’s plant (the “mill price”) plus the cost of shipping the product to him. Buyers are free to make their own transportation arrangements (and to pay for them). Alternatively, if the seller offers the option of delivering the product to the buyer’s location, the cost of shipping is invoiced separately. Under these assumptions, Stigler ([1942] 1987, p. 77) writes, “the price of a commodity ‘tends to uniformity’ for one reason: the buyers at point *B* refuse to pay more than the price at point *A* plus the cost of transportation, and the buyers at point *A* act similarly. Or the sellers act in this manner.”

In other words, according to Stigler, the market price is  $p + t$ , the mill price plus the unit cost of transportation, and locations *A* and *B* supposedly are both “in” the same market since the prices at the two points differ only by the cost of transportation between them. Marshall ([1890] 1930, p. 325) supplies a particularly apt example of the logic underlying the law of one price:

The whole of the Western World may, in a sense, be regarded as one market for many kinds of stock exchange securities, for the more valuable metals, and to a less[er] extent for wool and cotton and even wheat; *proper allowance being made for the expenses of transport*, in which may be included taxes levied by any customs houses through which the goods have to pass. (Emphasis added)

The law of one price, although usually expressed in terms of sellers’ transportation costs, does have one other embellishment: “mobility of customers [is]...sufficient to ensure the

tendency to uniformity in price, allowance being made for transportation costs of consumers.”

Buyers, that is, sometimes face lower transportation costs than sellers: “a cotton farmer will have a relatively small area in which he will sell his crop; the buyers may deal in every cotton-picking state” (Stigler [1942] 1987, p. 78). Fundamentally, however, recognizing that buyers are sometimes cheaper transporters than sellers does not alter the thrust of the law of one price. Two places are in the same market if the prices at the two places differ only by the cost of transportation between them, whoever the low-cost shipper is.

But is that proposition useful, or even true?

### **III. The Fundamental Economics of the Law of One Price**

An initial problem attends analysis of the law of one price: as normally stated, the law has at least two interpretations. Does the law mean that a market is definable as a location in which price is set by the marginal costs of production, differing only by transportation costs, *ceteris paribus*? Or does the law mean that, once a market has been identified, prices therein predictably will be uniform, allowing for transportation costs? That is, does equality of prices (but for transportation costs) define a market endogenously? Or does the delineation of the market, however it is defined exogenously, imply uniform prices (but for transportation costs)?

As discussed in this section, those propositions are not logically the same. Nor is the economic evaluation of the two plausible interpretations the same. Our analysis confines attention to the *ceteris paribus* conditions contemplated by the usual statement of the law of one price: reference to prices differing only by transportation costs means that all else (e.g., product quality) is held constant.

### A. Equality of Price Defines a Market

Let us interpret the law of one price, first, as stating that one can define places as belonging in a single market by their having the same price but for transportation cost. All firms by assumption have equal production costs. However, transportation costs to particular customers differ, being a function of distance from one of a firm's plants.

Consider the situation portrayed in Figure 1. Let two firms, 1 and 2, operate plants at points of local resource supplies, points *A* and *B* respectively. Spatially, *A* and *B* are located at distances *OA* and *OB*, measured from arbitrary point *O*. (For simplicity, there is no firm closer to point *O* than firm *A*, nor are there any customers to the left of point *A* or to the right of point *B*.) Each firm charges the f.o.b. price that covers its marginal production costs (*OP*), to which is added unit transportation cost ( $t_1$  for firm 1 and  $t_2$  for firm 2).<sup>5</sup> Thus, purchasers at points *A* and *B* will pay prices *OP*. Purchasers located away from points *A* and *B* would have to pay prices increasing with distance as shown along  $OP + t_1$  or  $OP + t_2$ .

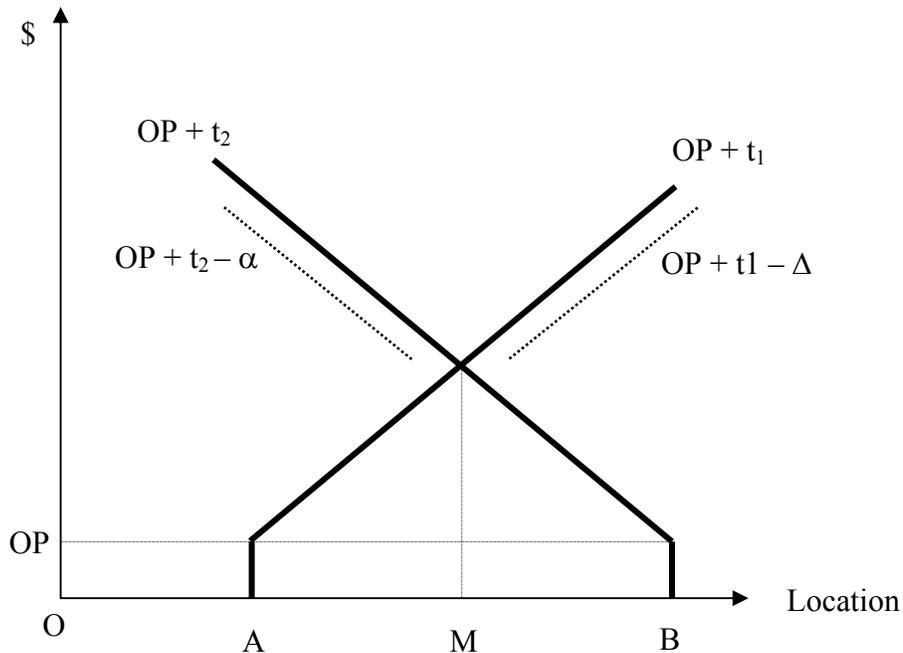
To turn to the question of interest, are points *A* and *B* in the same market? Under the first interpretation of the law of one price, the answer is no. Out to point *M*, all buyers will purchase from firm 1, the one producing at point *A*. But beyond *OM*, prices paid will no longer be firm 1's f.o.b. price plus transportation costs. Buyers at those distances will prefer to buy from firm 2. Point *M* is the boundary between two markets. Firm 1 serves all of the customers in the space up to *M*; firm 2 serves all of the customers beyond *M*.

If this first interpretation is what the law of one price means, it is economically problematic, for two reasons. First, more obviously, the law of one price effectively means that every plant comprises its own spatial (geographic) market. Area *AM* is one market; area *MB*

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<sup>5</sup> Firms 1 and 2 may have equal or different production and transportation costs without any important points of the analysis here being affected. Nor need transportation costs be a linear function of distance.

**Figure 1**



defines a separate market. Within each of these markets, there is not one price, but a multitude of prices tailored to individual customers' locations. Customers in  $AM$  pay firm 1's f.o.b. price plus the cost of transportation from point  $A$ . Customers in  $MB$  pay firm 2's f.o.b. price plus its transportation costs. Only at location  $M$  are both firms in the same market in the sense that they charge the same price,  $OP + t_1 = OP + t_2$ .<sup>6</sup>

This leads to the paradoxical result that, apart from the market boundary at  $M$ , firms are in the same market only if they are located atop one another. The moment that plants diverge spatially, under the law of one price they each define a separate market if they charge f.o.b. prices. In making every firm a market, the law of one price surely creates a definition of "market" that will seem of little operational use to most economists, and likely confuse most non-economists. Why use the term "market" if its meaning is identical to that of "firm" or

<sup>6</sup> F.o.b. pricing thus creates a natural territorial monopoly for each seller. Ironically, Stigler (1949) himself noted this point. Alternatively, since the same price is paid for the same thing at the same time only by the customers who are located a specific distance from a seller's plant, perhaps every point on  $OP + t_1$  and  $OP + t_2$  is a separate "market."

“plant”? Or if “market” refers to multiple firms at the same point, why make special note of transportation costs?

There is a second problem with this first interpretation of the law of one price. In Figure 1, would firms in fact charge prices equal to marginal production cost ( $OP$ ) plus transportation cost, as the law of one price says they would? Seemingly not, absent further assumptions. Out to point  $M$ , firm 1 can charge all of its customers up to some maximum price just  $\alpha$  below firm 2’s production and transportation costs. Likewise, beyond point  $M$ , firm 2 can charge all of its customers a maximum price just  $\Delta$  less than firm 1’s production and transportation costs.<sup>7</sup>

Again to quote Stigler (1987, p. 77), the law of one price works “for one reason: the buyers at point  $B$  refuse to pay more than the price at point  $A$  plus transportation, and the buyers at  $A$  act similarly.” But this Stiglerian notion of price formation assumes that only buyers matter in the setting of price within a market. If every firm is a market, then sellers by definition have some market power that must also be taken into account. In Figure 1, the sellers at  $A$  and  $B$  have no incentive to offer prices calibrated solely to their own production and transportation costs.<sup>8</sup> Only at  $M$ , where both firms are in the same market, need the price that one firm charges be

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<sup>7</sup> The hypothetical price schedules shown in Figure 1 are maxima, not necessarily the prices a profit-maximizing firm will charge. The appropriate model here is one of limit-entry pricing (e.g., Modigliani 1958); the limit price represents an upper bound, and the spatial set of prices actually chosen within that constraint will correspond to the quantities at which marginal revenue equals marginal cost. Depending on cost and demand conditions, those prices might increase away from a plant at a rate faster than shipping charges do, decrease at the same rate as shipping charges from the competing plant fall, or more likely track some pattern in between (Greenhut and Greenhut 1975). The set of prices charged might induce a new firm to enter and locate between points  $A$  and  $B$ , as in the standard Hotelling ([1929] 1952) model. Entry would cause the two existing firms to exit parts of their markets, but would result in a firm’s charging a price equal to its mill price plus its own transportation cost only if the two firms were located atop one another or at razor point  $M$ .

<sup>8</sup> If the market is contestable, price will be held to potential entrants’ marginal cost. But, except in the unlikely event of building its plant atop that of an existing firm, the law of one price would still dictate that the existing firm could charge a price more than its own production plus transportation cost. The exercise of local market power might likewise be constrained by buyers, if they can ship more cheaply than sellers (see note 10 below).

tightly constrained by the other firm. At that single point the price might actually equal the sum of marginal production and transportation costs.<sup>9</sup>

In other words, if under the law of one price each spatially separated plant defines a market, that plant has a locational monopoly. It therefore will not charge a price equal to its production and transportation costs, but rather a higher price limited by the *other* firm's production and transportation costs. Ironically, if there truly was a law by which price varies within a market only by transportation cost, firm 1's price would be a *negative* function of distance between points *A* and *M*. The highest prices would be charged at sites most isolated from competition from firm 2's plant at point *B* and the lowest prices at the market boundary.<sup>10</sup>

In short, if the law of one price is interpreted to mean that a market is defined by the area surrounding a firm (plant) where prices are the same but for transportation cost, two implications follow. First, every firm (plant) is a market, essentially stripping the term "market" of any useful meaning. And second, while price in the market is indeed a function of distance under this interpretation of the law, the limit price varies – not positively with own-firm distance, as the law of one price posits – but inversely with distance from other firms.<sup>11</sup> For firm 1, prices are higher

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<sup>9</sup> No statement of the law of one price refers to the number of firms, nor requires that the "one price" be a competitive one. Strictly speaking, the law of one price is a positive proposition, but it has obvious normative implications. Prices that just cover marginal (production plus transportation) costs maximize output and wealth, *ceteris paribus*. Obviously, in the absence of price discrimination, the first interpretation of the law of one price depicted in Figure 1 implies just the opposite: higher prices, reduced output and deadweight welfare losses.

<sup>10</sup> As noted above, buyers may be lower-cost shippers than sellers. But that possibility does not change any of the analysis here. Buyers closer to point *A* would still purchase only from firm 1, *ceteris paribus*; buyers closer to *B* would still purchase only from firm 2. Each firm operates in an isolated market over the relevant spatial distance. Moreover, firm 1 would still charge a price based on the cost of transportation from firm 2's market (that cost now determined by the cost to buyers, not sellers, of transporting from point *B*); firm 2's prices would be determined according to buyers' cost of transporting from firm 1's market.

<sup>11</sup> To the extent that firm 2 faces lower transportation costs than those shown in Figure 1, the size of its market relative to that of firm 1 increases, and the prices that the two firms charge will fall. To go one step further, to the extent that other firms face non-prohibitive transportation costs, entry by other firms becomes possible, and their production plus transportation costs will set an upper limit on prices any firm can charge. In the limit, if transportation costs are zero (e.g., securities or foreign exchange markets), then all firms wherever located are competitors, but then any interest in transportation costs as affecting price and defining markets disappears.

at  $A$  (close to the plant) than at  $M$  (further away). The same relationship between limit-price and distance would hold for firm 2.

### B. A Market Implies Price Equality

The key implication of the foregoing section is that, for a firm to charge a price at a point dictated by its own marginal production cost plus transportation, there must be other firms competing with it at that point, holding price equal to marginal cost (including both production and transportation costs). And so, if one observes different firms selling in the same place, each constraining other firms' ability to raise price above marginal production and transportation costs, that place would seem to define a market as the term is popularly used.

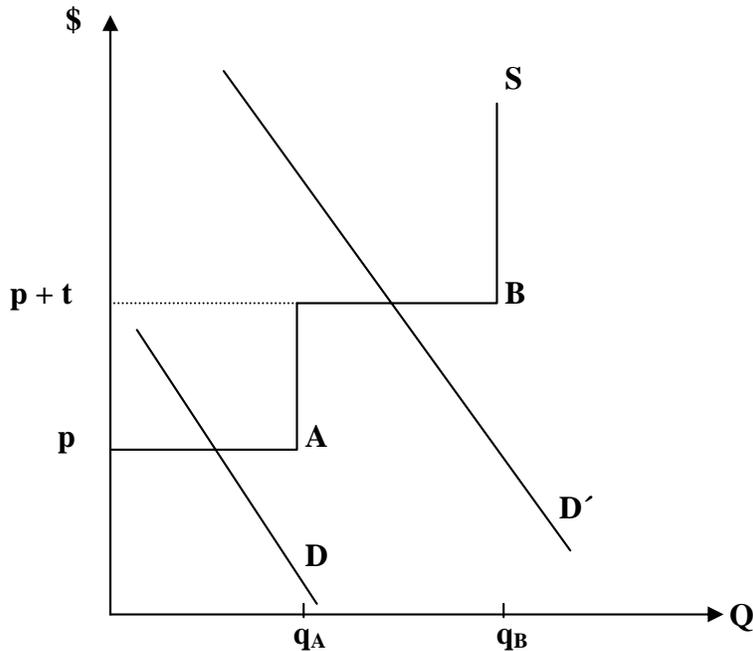
But in this locale (point  $M$ ) where multiple firms compete, if there is one price, is that single price equal to firms' production plus transportation cost, as the law of one price claims? Consider the situation depicted in Figure 2. A set of firms located at point  $A$  are willing to supply any quantity of output up to  $q_A$  units at price  $p$ . Another firm (or set of firms) located at point  $B$  has a higher supply price of  $p + t$  for sales in  $A$ .

Given multiple firms at  $A$ , if the demand for the product were  $D$ , the market price would be  $p$  and firms located at  $B$  would not be in the market.<sup>12</sup> The law of one price would apply, but only because all firms selling in  $A$  were located in  $A$ , as discussed in the previous section. But by hypothesis, firms located in both  $A$  and  $B$  have been observed selling in  $A$ . So, the demand for the product must be  $D'$ .

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<sup>12</sup> The only way firms at  $B$  can compete for sales at  $A$  would be to absorb freight charges, that is, to quote prices to customers in  $A$  that are less than the prices they charge in  $B$  plus transportation costs. That strategy is characteristic of a delivered pricing system where all sellers designate  $A$  as a basing point and which would, at least under some plausible circumstances (e.g., Haddock 1982, Carlton 1983), be consistent with pro-competitive behavior. But it would be inconsistent with the law of one price.

**Figure 2**



For firms in *B* to sell in *A*, the market price must be  $p + t$ .<sup>13</sup> Under the law of one price, all of the firms in the market charge the same price. But if so, some of them earn inframarginal rents owing to their more favorable location, because they charge prices exceeding their production and transportation costs. Locational rents are earned on sales to customers at *A* by local firms who would have been willing to supply them at price  $p$ , but actually can get  $p + t$ .<sup>14</sup>

<sup>13</sup> For a mathematical demonstration of this same point, showing that, in Nash equilibrium, Bertrand duopolists selling products differentiated only by location both charge prices of  $p^* = c + t$ , where  $c$  is the (constant) unit cost of production at the seller's plant and  $t$  is the unit cost of transportation to customers uniformly distributed along a line segment of length 1, see Mas-Colell et al. (1995, pp. 396–98). Mas-Colell et al. do not address the implications of their result for market definition, however.

<sup>14</sup> These locational rents may be quasi-rents, eventually capitalized in input prices. In that case, all firms charge the same price ( $p + t$ ) and none earns above-normal returns. Such an equilibrium is insightfully described by the most renowned of the masters:

The greater the number and revenue of the inhabitants of a town, the more extensive is the market which it affords to those of the country; and the more extensive that market, it is always the more advantageous to a greater number. *The corn which grows within a mile of the town, sells there for the same price with that which comes from twenty miles distance. But the price of the latter must generally, not only pay the expence of raising and bringing it to market, but afford too the ordinary profits of agriculture to the farmer. The proprietors and cultivators of the country,*

Once again, price is determined, not by a firm's own transportation costs, but as limited by the transportation costs of the more remote firm(s), just the opposite of what the law of one price posits.

The point is that, in either set of circumstances, the price is not one that “tends to uniformity, allowance being made for transportation costs”. Two places are not in the same market “if the prices at the two places differ by transportation costs”. For two places to be in the same market, it is necessary that the prices at the two places be the same, period.<sup>15</sup> If the sellers of an otherwise homogeneous product differ only as to location, they must charge the same price if they compete in one market. If they do not charge the same price, they are in the same market only if the boundary line between two other markets is defined as “the market.”<sup>16</sup>

### C. Reevaluating the Law of One Price

Recognizing that (unlike the law of demand, for example) the law of one price does not necessarily hold at all times in all places, economists have for a long time been ambivalent about it. As noted above, the law abstracts from any number of non-locational factors owing to which a buyer might not patronize a seller who is closest to him. Promptness of delivery, reputation,

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*therefore, which lies in the neighborhood of the town, over and above the ordinary profits of agriculture, gain, in the price of what they sell, the whole value of the carriage of the like produce that is brought from more distant parts, and they save, besides, the whole value of this carriage in the price of what they buy. Compare the cultivation of the lands in the neighborhood of any considerable town, with that of those which lie at some distance from it, and you will easily satisfy yourself how much the country is benefited by the commerce of the town. (Smith [1776] 1976, pp. 376–77; emphasis added)*

<sup>15</sup> Price equality is a necessary but not sufficient condition for defining a market. Though eggs may sell for \$13 per case in Moscow and \$13 per case in Chicago, the two cities are probably not in the same market.

<sup>16</sup> Although the same price must prevail in all parts of a properly defined *economic* market, one should not confuse the discussion here with *legal* (antitrust) definition of markets. Antitrust market definition asks what alternatives are (or will become) available to consumers if, hypothetically, one firm (or set of firms) attempts to impose a “small but significant and nontransitory” increase in price on them (Department of Justice/Federal Trade Commission *Horizontal Merger Guidelines*, § 1.1, April 2, 1992). Hence, for purposes of antitrust analysis, places that are not currently “in” the market on our interpretation of the law of one price might well be included when delineating the boundaries of the area within which the forces of supply and demand interact to constrain any attempt to exercise monopoly power (see, e.g., Landes and Posner 1981).

willingness to extend credit, warranty policies, and willingness to repair or replace defective items all may differ among firms. Other things are not always equal.

More recently, though, economists have offered more Coasean reasons why, *ceteris paribus*, the law of one price might not hold. Failures of the law have been ascribed to information or transaction-cost factors, for example. On the demand side, echoing Stigler (1961), Stiglitz (1993, p. 19) discusses imperfect information and buyer search costs as reasons why, “in fact, many markets are marked by noticeable differences in prices”.<sup>17</sup> Building on the work of Varian (1980), in which consumers are either informed or uninformed about the distribution of prices and sellers randomly conduct sales, Baye and Morgan (2001, 2002) propose a model of Internet pricing wherein a gatekeeper charges fees to firms wanting to advertise prices and to consumers wanting to access the price information. Prices for homogeneous goods are shown to be dispersed in equilibrium under those assumptions. Asplund and Friberg (2001) rely on “costs of arbitrage” to explain why the prices of the same goods quoted in different currencies at the same duty-free shops fail to converge in apparent violation of the law of one price. Similarly, Goldberg and Knetter (1997, p. 1270) conclude that “deviations in the law of one price” observed in otherwise integrated international markets “appear to be largely a result of third-degree price discrimination.”

On the supply side, Dennis Carlton and Jeffrey Perloff (2000, p. 365, n. 35) write, “Because prices reflect costs in competition, economists expect purchasers to pay for FOB pricing and for actual freight under competition.” But in fact, Carlton and Perloff continue, firms often do not charge for shipping, using uniform delivered pricing (a single freight charge,

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<sup>17</sup> If the appropriate interpretation of the law is that depicted in Figure 1 above, imperfect information might also lead to more than one firm selling in a market where another firm, perfectly informed, could price so as to maintain a total monopoly. Firm 1 may not know perfectly what firm 2’s costs are, and so choose a limit price that is high enough to allow firm 2 to compete with firm 1.

regardless of distance) instead “because it is simple and saves on administrative costs.... It appears that uniform delivered pricing is often followed as long as the variation in freight charges among customers is 10 percent or less”.<sup>18</sup> Or, George Hay writes, the law may not hold at any given point because temporally the system is in disequilibrium: “While it is true that in a ‘perfect’ market prices for identical products tend toward equality, there is generally enough friction in the system that the process does not work instantly” (Hay 1999, p. 196).

In short, modern economists who have considered the law of one price do not seem to regard it as falsifiable. When price does not equal marginal production plus transportation costs, *dei ex machinis*, such as asymmetric or costly information, price discrimination, transaction costs or disequilibrium, are invoked to save the law. Being consistent with any observed pattern of prices, the “law” of one price predicts nothing.

The analysis here illustrates that frictions like transaction and information costs, while perhaps sufficient, are not necessary to question the real-world usefulness and validity of the law of one price as a tool for defining market boundaries. Even when analyzed in its starkest terms, where transportation cost is the only complication allowed, the law is inherently contradictory. In that simplest case, the most straightforward interpretation of the law implies that every firm or plant is a separate market, that prices within that market vary by customers’ locations and that prices in one market may well be a negative function of transportation costs from adjacent markets, not a positive function of transportation costs for the particular market itself. Interpreted another way, the law of one price is a law of one price, not a law of one price adjusted for differences in transportation costs. In other words, under this alternative interpretation

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<sup>18</sup> Transportation typically occurs from shipping hubs (often, big cities) rather than from every single point on the spatial continuum. In Illinois, producers in Joliet are some 50 miles closer to Los Angeles than those in Waukegan. But these cities are more or less equidistant from Chicago, the point where shipments to Los Angeles are aggregated, and so face equivalent costs to ship to Los Angeles.

transportation costs generate Ricardian rents for favorably located sellers, but do not result in price differences within a market.

There is a law of one price, but it is not the one stated by Alfred Marshall or by George Stigler. The transportation-cost qualification they appended erroneously added an element of spatial product differentiation to a proposition that was meant to apply only to perfectly competitive markets, wherein knowledge is perfect and goods are costlessly mobile. The original meaning can be restored by defining a market as Cournot did: “the entire territory of which the parts are so united by the relations of unrestricted commerce that prices take the same level throughout with ease and rapidity.” Jevons’ law of indifference is equally apt: “in the same open market, at any one moment, there cannot be two prices for the same kind of article” (quoted in Edgeworth [1896] 1987, p. 786). Alternatively, one can define a market in amended Stiglerian terms as

the area within which the price of a commodity tends to uniformity. That is, two places are in the same market for a good if the prices at the two places are the same.

#### **IV. Conclusions and Implications**

The foregoing analysis demonstrates that, encumbered with its usual transportation-cost proviso, the law of one price is incoherent. It cannot therefore be rescued by attempting to control for other complications of the real world. Given that “most retail markets are ... characterized by a rather large degree of price dispersion” (Varian 1980, p. 651), it should come as no surprise that some economists have been prompted to recommend jettisoning the law of one price altogether: “economists have belatedly come to recognize that the ‘law of one price’ is no law at all” (*ibid.*). Routinely observed phenomena, such as f.o.b. pricing, the willingness to absorb freight to sell to

distant customers and the “high degree of overlap and cross-shipping found among spatially dispersed producers,” all “obviate the usefulness” of the law (Elzinga and Hogarty 1973, p. 51).

But the law of one price restated by “the masters,” as Stigler refers to them, is a more subtle proposition than those writing about it have grasped. Errors of interpretation have been multiplied by failing to be clear about just what the law means. If it means that price equality defines a market, then the law is of no use, except in the minority of instances in which transportation cost is essentially zero: every production site is a market, robbing the latter term of any relevance. It is also wrong. Price does not necessarily vary positively with a producer’s transportation costs; the upper limit on price varies negatively with adjacent producers’ transportation costs.

If, alternatively, the law means that a market (however defined) will exhibit prices that are equal but for spatially-dispersed firms’ own transportation costs, the law again is incorrect. It is not true that “two places are in the same market for a good if the prices at the two places differ by transportation costs” (Stigler 1987, p. 77). Rather, any number of plants can compete in any given *marketplace* as long as each quotes the same price, though they may or may not compete in other marketplaces. Under the usual simplifying assumptions, all other things equal, as spatially separated firms face important transportation costs, the number of places in which they compete will diminish. Within a market, however, it is only the marginal producer’s transportation costs that matter. Corn shipped to town from distant locations, as Adam Smith long ago recognized, sells at the same price as corn shipped from nearby farms, whose owners thereby benefit.

Stripped of interpretative errors, the law of one price must prevail. Otherwise, it is merely is a “tendency” that follows as a logical consequence of the model of pure competition, offering

no added advantage over that model. Qualifying the law of one price to make allowance for transportation costs turns out to have been a mistake, subsequently multiplied by trying to force it also to be consistent with other messy properties of the real world, such as transaction and information costs. That error has caused economists to treat the law of one price the same way that Montana's drivers treated the 55 mile-per-hour legal speed limit. Most knew the law was on the books (or, more accurately, in the books), but few observed it, or expected others to.

## **References**

- Asplund, Marcus and Richard Friberg (2001), "The Law of One Price in Scandinavian Duty-Free Stores", *American Economic Review*, **91**, 1072–83.
- Baye, Michael R. and John Morgan (2001), "Information Gatekeepers on the Internet and the Competitiveness of Homogeneous Product Markets", *American Economic Review*, **91**, 454–74.
- Baye, Michael R. and John Morgan (2002), "Information Gatekeepers and Price Discrimination on the Internet", *Economics Letters*, **76**, 47–51.
- Carlton, Dennis W. (1983), "A Reexamination of Delivered Pricing Systems", *Journal of Law and Economics*, **26**, 51–70.
- Carlton, Dennis W. and Jeffrey M. Perloff (2000), *Modern Industrial Organization*, 3rd ed., New York: Addison-Wesley.
- Chamberlain, Edward H. ([1933] 1962), *The Theory of Monopolistic Competition: A Re-orientation of the Theory of Value*, 8th ed., Cambridge: Harvard University Press.
- Cournot, Augustin ([1838] 1927), *Researches into the Mathematical Principles of the Theory of Wealth*, trans. by Nathaniel T. Bacon, New York: Macmillan.
- Edgeworth, Francis Y. ([1896] 1987), "Indifference, Law of", in John Eatwell, Murray Milgate and Peter Newman (Eds.), *The New Palgrave Dictionary of Economics*, vol. 2, London: Macmillan and New York: Stockton Press, pp. 786–87.
- Ekelund, Robert B. Jr. (1970), "Price Discrimination and Product Differentiation in Economic Theory: An Early Analysis", *Quarterly Journal of Economics*, **84**, 268–78.
- Elzinga, Kenneth G. and Thomas F. Hogarty (1973), "The Problem of Geographic Market Definition in Antimerger Suits", *Antitrust Bulletin*, **18**, 45–81.

- Elzinga, Kenneth G. and Thomas F. Hogarty (1978), “The Problem of Geographic Market Delineation Revisited: The Case of Coal”, *Antitrust Bulletin*, **23**, 1–18.
- Goldberg, Pinelopi Koujianou and Michael M. Knetter (1997), “Good Prices and Exchange Rates: What Have We Learned?”, *Journal of Economic Literature*, **35**, 1243–72.
- Greenhut, John G. and Melvin L. Greenhut (1975), “Spatial Price Discrimination, Competition, and Locational Effects”, *Economica*, **42**, 401–19.
- Haddock, David D. (1982), “Basing-Point Pricing: Competitive vs. Collusive Theories”, *American Economic Review*, **72**, 289–306.
- Hay, George A. (1999), “Facilitating Practices: The Ethyl Case”, in John E. Kwoka, Jr. and Lawrence J. White (eds), *The Antitrust Revolution: Economics, Competition, and Policy*, 3rd ed., New York and Oxford: Oxford University Press, pp. 182–201.
- Horowitz, Ira (1981), “Market Definition in Antitrust Analysis: A Regression-Based Approach”, *Southern Economic Journal*, **48**, 1–16.
- Hotelling, Harold ([1929] 1952), “Stability in Competition”, *Economic Journal*, **34**, 41–57, reprinted in George J. Stigler and Kenneth E. Boulding (eds.), *A.E.A. Readings in Price Theory*, Chicago: Richard D. Irwin, pp. 467–84.
- Jevons, W. Stanley ([1871] 1970), *The Theory of Political Economy*, ed. by R. D. Collinson Black, Baltimore: Penguin.
- Kaldor, Nicholas (1934), “Mrs. Robinson’s ‘Economics of Imperfect Competition’”, *Economica*, **1**, 335–41.
- Landes, William M. and Richard A. Posner (1981), “Market Power in Antitrust Cases”, *Harvard Law Review*, **94**, 937–96.
- Lipsey, Richard G., Paul N. Courant and Christopher T. S. Ragan (1999), *Principles of Microeconomics*, 12th ed., Boston: Addison-Wesley.
- Mankiw, N. Gregory (2004), *Principles of Economics*, 3rd ed., Mason, OH: Thomson South-Western.
- Marshall, Alfred ([1890] 1930), *Principles of Economics: An Introductory Volume*, 8th ed., London: Macmillan.
- Mas-Colell, Andreu, Michael D. Whinston and Jerry R. Green (1995), *Microeconomic Theory*, New York and Oxford: Oxford University Press.
- Modigliani, Franco (1958), “New Developments on the Oligopoly Front”, *Journal of Political Economy*, **60**, 215–32.

- Moore, Henry L. (1906), "Paradoxes of Competition", *Quarterly Journal of Economics*, **20**, 211–30.
- O'Sullivan, Arthur and Steven M. Sheffrin (1988), *Microeconomics Principles and Tools*, 2nd ed., Upper Saddle River, NJ: Prentice-Hall.
- Robinson, Joan ([1933] 1969), *The Economics of Imperfect Competition*, 2nd ed., London: Macmillan.
- Shrives, Ronald E. (1978), "Geographic Market Areas and Market Structure in the Bituminous Coal Industry", *Antitrust Bulletin*, **23**, 589–625.
- Smith, Adam ([1776] 1976), *An Inquiry into the Nature and Causes of the Wealth of Nations*, vol. I, The Glasgow Edition of the Works and Correspondence of Adam Smith, ed. by R. H. Campbell and A. S. Skinner with W. B. Todd, Oxford: Clarendon Press.
- Stigler, George J. ([1942] 1987), *The Theory of Price*, 4th ed., New York: Macmillan.
- Stigler, George J. (1949), "A Theory of Delivered Price Systems", *American Economic Review*, **39**, 477–89.
- Stigler, George J. (1961), "The Economics of Information", *Journal of Political Economy*, **64**, 213–25.
- Stigler, George J. (1968), "Price and Nonprice Competition", *Journal of Political Economy*, **72**, 149–54.
- Stigler, George J. and Robert A. Sherwin (1985), "The Extent of the Market", *Journal of Law and Economics*, **28**, 555–85.
- Stiglitz, Joseph E. (1993), "Information", in David R. Henderson (ed.), *The Fortune Encyclopedia of Economics*, pp. 16–21, New York: Warner Books. Available online at [www.econlib.org/library/Enc/Information.html](http://www.econlib.org/library/Enc/Information.html).
- Varian, Hal R. (1980), "A Model of Sales", *American Economic Review*, **70**, 651–59.