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COMMENTS ON TISDELL'S CRITIQUE OF NERLOVE-WAUGH THEOREM CONCERNING OPTIMAL ADVERTISING

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Tisdell's evaluation of the Nerlove-Waugh theorem concerning optimal advertising for a competitive industry without supply control is examined. This examination supports the continuing validity of the major implications of the theorem.

In the September, 1976, issue of this *Review*, Tisdell [3] discusses alternative optimal advertising strategies for the wool industry. The first part of Tisdell's article questions the relevance of the Dorfman-Steiner [1] and Nerlove-Waugh [2] theorems concerning advertising. The purpose of this note is to question Tisdell's critique of the Nerlove-Waugh (N-W) theorem.

Tisdell summarizes the main implications of the N-W theorem about optimal advertising intensity for a competitive industry without supply control as follows:

> They [Nerlove-Waugh] broadly conclude that an industry's optimal ratio of advertising expenditures to sales rises (1) with the inelasticity of the supply of its products, (2) with the elasticity of demand for its product with respect to advertising and (3) with falls in the own price elasticity of demand for its products, as each one of these factors varies and other things are held constant [3, p. 103].

Tisdell later questions the theoretical basis of the N-W theorem because it assumes that advertising horizontally displaces a Marshallian demand curve, a curve for which quantity of the product is measured on the horizontal axis. He asserts that different conclusions result if one assumes advertising produces a vertical displacement of the demand curve. This seems to be unusually perplexing, but intriguing, since the profitability of a given activity designed to produce a specific shift in a given demand function should not depend on whether the displacement is measured vertically or horizontally.

Implications of the N-W theorem clearly depend on the marginal gross revenue associated with a displacement of a given demand curve, induced by a change in advertising, holding price constant. In their mathematical derivation this was defined to be $P.\partial D/\partial a = \alpha$ where D is defined to represent product demand, a is advertising expenditures and P is product price at which the partial derivative is evaluated. A particular price

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elasticity of demand is all that is required to compute the vertical displacement of the demand curve induced by the change in advertising implied by a particular value of α. With P being held constant, differences in α are directly attributable to differences in $\partial D/\partial a$. Combining the latter derivative with the price elasticity of demand for the product implies a specific value of the vertical displacement of the demand curve induced by the advertising under analysis. The value of $\partial P/\partial a$, holding quantity constant, is equivalent to dividing α by the price elasticity of demand multiplied by the original equilibrium quantity. Since horizontal and vertical displacements are always going to be related in this manner, it should not matter how one measures the effect of advertising since the estimate of α would be unaffected for purposes of the N-W theorem.

Tisdell furthermore argues that it is a mistake to use the N-W results to argue that profitability of promoting a product necessarily falls, other things equal, as the demand for the product becomes more elastic. Part of his argument seems to be based on price elasticities of a displaced linear demand curve differing if one considers elasticity at the points of vertical or horizontal displacement. This seems to miss the point regarding differences in price elasticity of demand embodied in N-W results. Their results indicate the marginal profitability from advertising is equal to $\{-1 + \alpha/(\varepsilon - n)\}$ where ε is the price elasticity of industry supply, n is the price elasticity of demand, and α is as defined above. Marginal profitability has to decrease holding α and ε constant for a more elastic demand. A subtle point associated with the result is that it is elasticities at the initial equilibrium that are relevant for this evaluation and not elasticities at alternative points along the displaced curve. Ordinarily one would not be concerned with possible changes in elasticities for marginal analysis in a comparative static setting since the limiting processes involved with differential calculus as employed by N-W implicitly assume constant elasticities. When mathematical results derived from differential calculus are magnified for graphical presentation using linear functions as Tisdell has done, it is important to note at which point the elasticities are defined.

In addition to the above problem with Tisdell's graphical analysis, there seems to be some confounding of effects of different elasticities of demand with how "equivalent" shifts in demand should be measured. In the accompanying Figure 1, reproduced from his article, D_1 and $\overline{D}_1$ are used to represent alternative demand functions with different price elasticities at point e. D_2 and $\overline{D}_2$ are assumed to represent parallel shifts in D_1 and $\overline{D}_1$, respectively, in response to a given advertising expenditure. Given a horizontal shift of em in each of the original demand functions, consistent with a specified value of α, the change in producers' surplus using the same supply curve (S) in each case is obviously smaller for the more elastic demand curve, *aefb* v. *aegc*. At this point however Tisdell suggests it is inappropriate to consider D_2 and $\overline{D}_2$ as representing "equivalent" shifts in demand because of the disparity in the vertical shifts of the two demand functions under consideration. Consequently Tisdell introduces a new demand schedule $\hat{D}_2$ for comparison purposes.

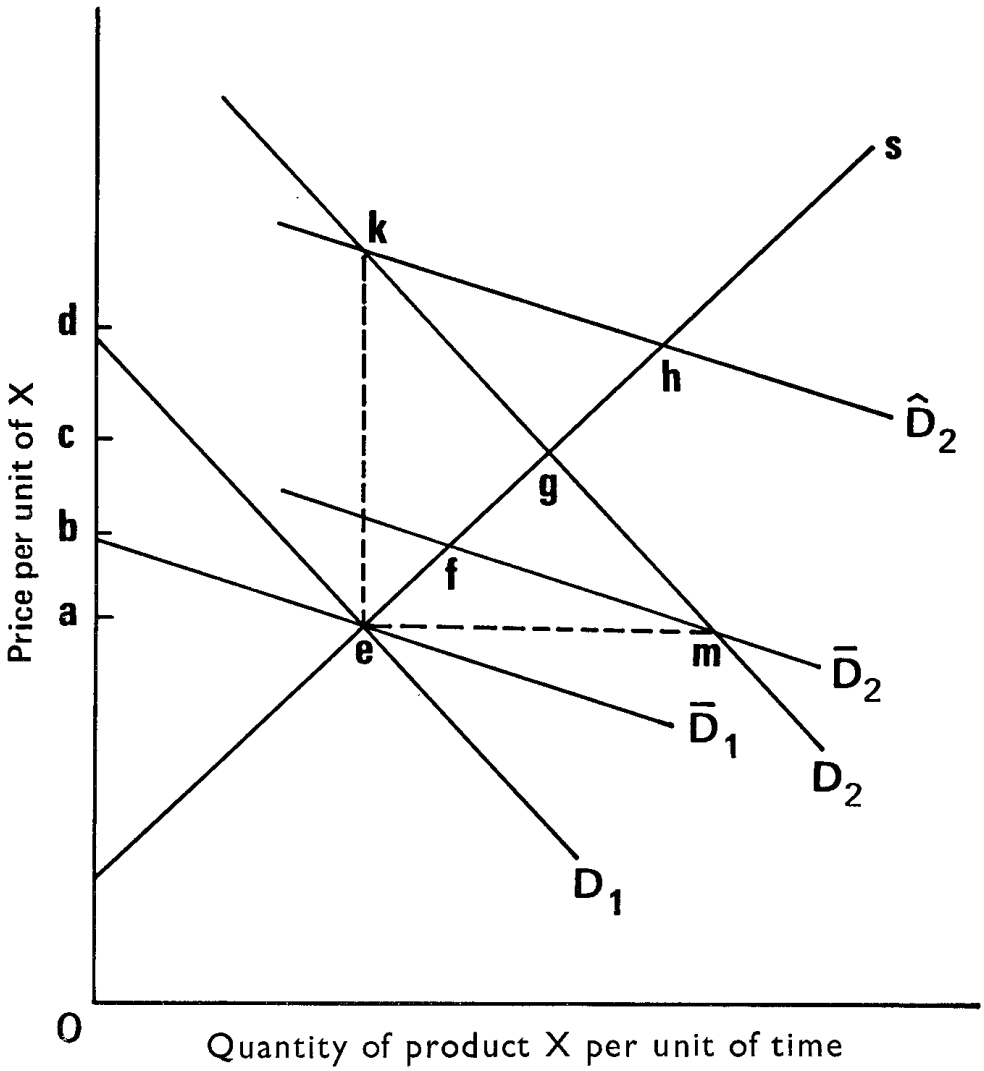

FIGURE 1

$\hat{D}_2$ is defined to be parallel to $\bar{D}_1$ with the same vertical distance between $\hat{D}_2$ and $\bar{D}_1$ as between D_2 and D_1. Obviously the change in producers' surplus resulting from a change in demand from $\bar{D}_1$ to $\hat{D}_2$ is much greater than the change associated with a change from D_1 to D_2. The latter result is entirely consistent with the N-W theorem, however, since the change from $\bar{D}_1$ to $\hat{D}_2$ implies a much larger value of α than the change from D_1 to D_2. It is the difference in α's that is responsible for the increased profitability rather than how the shift in demand is measured or the difference in elasticities.

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