

Hotelling's "Ice Cream Dealers" with Elastic Demand

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ABSTRACT This article reconsiders the Hotelling duopoly model of 1929, but under elastic demand, more precisely a linear demand function. The equilibrium state for identical firms is fully described, and the intervals of different regimes: independent monopolies, genuine duopoly competition, and price cutting wars, are specified in terms of one single compound parameter (maximum price, minus marginal production cost, divided by transportation cost).

Hotelling's seminal contribution of 1929 was one of several successful attempts to give a precise interpretation to Bertrand's sweeping criticism, dated 1883 of Cournot's duopoly model of 1838. Chamberlin's of 1932 was another. The common point was that if the commodity were homogenous, and the competitors were quantity adjusters, as originally assumed by Cournot, then any one competitor could, by undercutting the other competitor's price, however slightly, recover the entire market as its share. This would lead to instability of equilibrium - a price war ending first at the point when marginal costs were barely covered. In accordance with Bertrand's objection, both Hotelling and Chamberlin assumed price, instead of quantity, to be the decision variable. Chamberlin assumed the commodity, as perceived by the consumers, to be heterogeneous, so that they would have preference for one brand (or dealer) among similar ones, and only gradually desert their favourite brand (or dealer) when price differences grew too much adverse. Hotelling, in contrast, assumed the commodity to be perceived as perfectly homogenous by the consumers, but incorporated space, location, and transportation costs, which provided each competitor with a local monopoly area, with competition only at the fringes. In this way Hotelling's variant included a location problem. To simplify analysis, Hotelling assumed demand to be completely inelastic. This made the establishing of local monopolies unstable. In order to maximise their market shares, both competitors would eventually crowd in the same point, which would again end in a price war. So, what Hotelling showed was that his suggested solution was no solution. To judge from the passing comments to his formal model, Hotelling roughly understood how the case would work out with elastic demand: There would remain a tendency for the competitors to gravitate closer together than placing themselves in the centres of their respective markets, but it would no longer lead to clustering in the same point as in the case of inelastic demand. However, Hotelling did not analyse elastic demand formally, and this set the tradition for following re-maintreatments of his case. This made Hotelling's theory a theory of location, and it is almost forgotten that it primarily was aimed at being a theory of duopoly pricing. Therefore, the present author thinks it is rewarding to pin down the facts of Hotelling's model with elastic demand. Lerner and Singer in their ingenious graphical discussion of 1937 took the first step, by assuming a given reservation price, such that whenever the actual price was lower, the customers would buy a fixed quantity of the commodity, whenever it was higher, they would buy nothing. Later, in 1941, Smithies replaced this step function by a linear decreasing demand function, and presented an insightful verbal analysis for it, though he still considered the problem "*too complex to be treated by rigorous methods*". However, the neat formal analysis of the pricing problem under monopoly by Beckmann 1968 and 1976, can easily be extended to duopoly.