The Kinked Demand Curve

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March 15, 2007

The kinked demand curve (Sweezy, 1939; Hall and Hitch, 1939) has been one of the staples of oligopoly theory. It was originally formulated as a theory of price rigidity. A firm conjectures that its rivals will match its price if it reduces the price, but will not match its price if it initiates a price increase. This gives rise to a kink in the firm's perceived demand curve, at the prevailing price. The consequent discontinuity in its marginal revenue curve implies that the firm will not adjust its price in response to small changes in costs, giving rise to price rigidity.

In contrast with the standard Cournot or Bertrand models, the theory represents one of the first attempts at a dynamic model of oligopoly. However, this modelling has been criticized. Implicit in the analysis is the assumption that the firm is motivated by its profits after all price adjustments have taken place. That is, profits in the time interval, where a firm has cut its price and before its rivals have responded, are insignificant. However, if this is so, why does a firm in a symmetric oligopoly not initiate a price increase? If its rivals fail to respond in kind, it can rescind the original increase. Knowing this, its rivals would have an incentive to match its price increase, as long as the original price was below the monopoly price.

To address these questions, one needs to formulate oligopolistic interaction as an explicit dynamic game. The first option is the standard repeated game model, where one obtains an embarrassment of riches – the "folk theorem" states that every individually rational feasible payoff is an equilibrium payoff, as long as firms are sufficiently patient. [1]Second, one can model price setting as a dynamic "pre-game", with profits depending only on the profile of final prices that results. This is the modelling choice adopted by Bhaskar (1988) and Kalai and Satterthwaite (1986). Third, Maskin and Tirole (1988) analyze the Markov perfect equilibria of a repeated game where firms take turns in choosing price. These theories of the kinked demand curve are not theories of price rigidity. In all these models, a firm is deterred from undercutting price by the knowledge that its rivals can respond. In consequence, they may be thought of as models of oligopolistic collusion.

[1] Anderson (1988) provides a foundation for the kinked demand curve in terms of "quick response equilibria" of a repeated game, where the period length shrinks to zero.

We set out a variant of the model of Kalai and Satterthwaite, possibly the simplest of these models. Consider a homogeneous good oligopoly with n firms, where firm i has constant marginal costs c_i. Let $D(p)$ denote market demand when p is the lowest price in the market, and assume that the revenue function, $p.D(p)$, is strictly concave. The game played by the firms has two stages, as follows. In stage 1, firms simultaneously choose prices. Given the vector of prices chosen, $(p_1, p_2, ..., p_n)$, let $\bar{p}$ denote the smallest of the prices chosen. In stage 2, firms may choose any price greater than or equal to $\bar{p}$ .Our focus is on subgame perfect equilibria where firms do not use weakly dominated strategies in stage 1, given subgame perfect continuation play in stage 2. Let p_i^* denote firm $i's$ optimal common price, i.e. the unique maximizer of firm i's profits when all firms choose the same price, $p_i^* = \arg\max_p \frac{1}{n}(p - c_i)D(p)$.Without loss of generality we may assume that firm 1 has the *minimum optimal common price*. If the cost asymmetries between firms are not too large, then this game has a unique equilibrium. In the first stage, each firm chooses p_i^*, and in stage 2, all firms reduce their prices to p_1^*. That is, the equilibrium outcome is at the minimum optimal common price. The intuition for this results is as follows. In stage 2, one has Bertrand competition with a price floor at $\bar{p}$, the smallest price chosen at stage 1, and all firms will choose $\bar{p}$ as long as it is not too low. Given this, a firm knows that it influences the common equilibrium price only in the event that its price is lower than everyone else's. This ensures that it is weakly dominant at stage 1 for the firm to choose p_i^*.

The model set out here incorporates a restriction on stage two behavior, that no firm can price below the lowest price chosen at stage 1. To avoid this restriction on undercutting one must formulate a dynamic game without a last stage, since otherwise the Bertrand outcome is irresistible. Bhaskar (1988) sets out a duopoly formulation where firms may repeatedly revise prices downward, and the pre-game ends when no firm seeks to reduce its price. This game produces a similar equilibrium outcome to the one set out above. The theory does not imply price rigidity – if costs increase for firm 1, then this will increase the equilibrium price. The theory also has a flavour of price leadership, since the lowest cost firm effectively selects the equilibrium price, with the follower firms having to follow suit. Indeed, the follower firms perceive a kinked demand curve at the equilibrium price. If a follower firm were to choose a higher price, firm 1 would not follow suit, thus ensuring that no other firm does so, while if it reduces price, all firms would match this.

Maskin and Tirole (1988) analyze a repeated duopoly where a firm's price is kept fixed for two periods, and where firms alternate in choosing price. They find multiple Markov perfect equilibria, with the unique symmetric renegotiation proof equilibrium giving rise to a kinked demand curve at the monopoly price.

The traditional kinked demand theory has been criticized on empirical grounds (Stigler, 1947; Pimeaux and Bomball, 1974) since oligopoly prices do not appear to be excessively rigid, nor do they show the predicted asymmetry. However, this is not a prediction of the reformulated theories. These theories do predict that in any market, $n-1$ firms (i.e. all firms except the leader) should *expect* their rivals to respond asymmetrically to their price changes, at the equilibrium price. Bhaskar, Machin and Reid (1991) analyze survey evidence, where firms were asked how they expected their rivals to respond if they changed price. The survey data finds evidence of asymmetry in expected responses that is consistent with the prediction.

References

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