Virtual Corporate Reality (VCR) is a classroom simulation of a differentiated products oligopoly market designed to enhance students’ understanding of game theory concepts in the economics of industrial organization.

The market share of each product is the fraction of consumers that buy it. The borders of each product’s market share on the circle are located where a consumer is indifferent between this product and the nearest alternative product.

The indifferent consumer derives the same consumer surplus from both the product on the left of her and the product on the right of her. Each consumer only prefers the product located at her location and derives maximum consumer surplus from it. The disutility of the consumer that is not buying her ideal product increases linearly as the distance between the consumer and the product grows. Consumer surplus is further diminished by the price the consumers pay for the product.

The indifference price is the price that a consumer is indifferent to paying. Each consumer located at a point on the circle has a particular indifference price. The difference in consumer surplus between the indifference price and the price the consumer actually pays is the consumer surplus.

The consumer surplus is further diminished by the price the consumer pays for the product.

Consider n firms with zero relocation cost. They will follow the principle of “maximum differentiation” to minimize price competition, and locate evenly around the circle, at distances 1/n from each other. Firms will only enter the market if they can recoup their entry costs, thus earning at least zero economic profit. As entry continues, however, there will come a point where n is so large that all firms earn negative profits under Nash equilibrium. This threshold will tell us how many different single-product firms the market can support, at the point where entry is no longer profitable. Our results show that this threshold is n = 30, meaning that the market can support 20 different single-product firms. Notice that this value of n is smaller than the maximum value shown in Figure 4.

When does entry become unprofitable?

If one of those firms at the threshold becomes a multi-product firm, it can internalize the price effect of its own nearby products and thus choose to set higher prices and earn higher profits under Nash equilibrium. Then the question becomes at what point this firm no longer finds it profitable to introduce another product. We find that a multi-product firm will have 50 products for a total of 78 products in the market. Notice that this single product below the number of products that make the market size negative.

Figure 4: The total number of consumers in the market determines the size of the market. In VCR, it is a quadratic function of the number of products (n), which reaches its maximum at n = 40.

The Nash Equilibrium Prices in VCR:

The strategic variable is price and the strategy space of all firms is [0, 6]. The payoff function is firm’s profit.

The best response is found by taking first-order conditions of profits and solving a system of equations (one for each FOC).

Firms price at Nash equilibrium where no firm can increase its profits (by changing its price given that all other firms’ prices).

Note that introduction affects all Nash equilibrium prices, with the product furthest away being least affected.

Figure 5: An illustration of Nash equilibrium prices, described below.

Figure 6: A merger will suppress prices for all but the merged firms and drive profits down. The immediate neighbors of the new multi-product firm (firms C and E) will feel the greatest effect, whereas firm D located furthest away at 0.5 would be least affected.

Credible spatial preemption through location choice (shielding)

Kenneth Judd (1985) describes a scenario in which the incumbent has products at every hour around the clock (12:00, 10:00, 20:00, etc.) and examines two strategies of entry prevention:

Strategy 1: The incumbent threatens to stand fast if the entrant introduces a product at 12:30.

Strategy 2: The incumbent threatens to stand fast if the entrant introduces the exact same product as the incumbent at 12:00 (a direct attack).

Our results: Our setup is described in Figure 7. Unlike in Judd’s scenario, however, the incumbent only starts out with one product at the top of the circle and both the incumbent and the entrant have a choice of exactly where to introduce. We examine whether the entrant can protect her market share from entry by “shielding” with introductions around her product. We find that there are multiple values of d and h for which both players stay in the stage 3 subgame. Thus, the incumbent does not have a credible threat of foreing the entrant out, but it is also profitable for her to stay. This distinction from Judd’s conclusion will be the source of future work.

Sources:

Figure 7: Entry/exit game set-up in our analysis.

Stage 1: The market has 4 symmetrically located firms and the firm at 0 chooses whether to introduce products at 1 and .

Stage 2: An outside entrant (or, one of the existing firms) decides whether to introduce product at h.

Stage 3: Firms compete in price and earn profits.

Table 1: Nash equilibrium prices and profits for the two goods at 12:00 will drop to market price of 0.

Table 2: Nash equilibrium prices and profits for the two goods at 12:00 will drop to market price of 0.

Table 3: Nash equilibrium prices and profits for the two goods at 12:00 will drop to market price of 0.