Exam ECON3820/4820 Spring 2024

Instructions: This exam consists of five questions, all weighted equally towards the final grade on the exam. Please apportion your allotted time so that you are able to answer all questions. Show all your work for the mathematical problems, as partial credit may be awarded. You have three hours to complete this exam.

Question 1 – differentiated goods versus homogeneous goods

Discuss the models of price and quantity competition in differentiated product markets. How do these models differ from the homogeneous product case, and what are the implications for market outcomes? No mathematical modelling is required for a perfect score on this question, as long as you explain well. You may support your explanations with figures as you see fit.

Answer

- **Homogeneous Products**:
  - Models include Cournot and Bertrand.
  - Firms compete only on quantity (Cournot) or price (Bertrand).
  - Because goods are perfect substitutes, consumers are willing to switch to the cheapest provider even if the price differential is really small. This creates a strong incentive to undercut your opponent. In Bertrand competition with homogeneous goods, price equals marginal cost, resulting in zero economic profit.
  - Differentiation leads to market power, allowing firms to charge above marginal cost.
- **Differentiated Products**:
  - Firms compete on price and other factors like quality, location, and brand.
  - Differentiation reduces the intensity of the price competition, because a firm cannot steal all their competitors' customers by lowering the price a small epsilon, e.g. due to brand loyalty and product uniqueness.
  - Equilibrium with positive profits is possible, unlike with homogeneous goods.
  - The workhorse are the reduced-form price and quantity competition models, which we motivated by showing that they can arise from e.g. Hotelling's location model, Salop's circle model, and the vertical differentiation model in which firms strategically choose their position in some product characteristics space.

Question 2 – subgame-perfect equilibrium

Explain the concept of subgame perfect equilibrium in the context of capacity pre-commitment before price competition. How does it alter the strategic behavior of firms compared to simultaneous price setting without capacity constraints? No mathematical modelling is required for a perfect score on this question, as long as you explain well. You may support your explanations with figures as you see fit.

Answer

- **Subgame Perfect Equilibrium (SPE)**:
  - A game is divided into subgames, where a subgame is any part following a player's action, e.g. the current action and all future actions in games where timing matters.
  - SPE is defined as a strategy profile that represents a Nash equilibrium in every such subgame of the original game.
  - Involves forward-looking behavior, anticipating reactions from competitors and thus eliminating empty threats.
- **Capacity Pre-Commitment**:
  - Two stages: Firms decide on capacities before competing on prices. Goods are perfect substitutes
  - Once capacities are installed, they become common knowledge. If sufficient capacity is installed, the second-stage equilibrium will give zero profits – the competitive nature is just as if they had unlimited capacities as in the Bertrand model
  - Realizing that this will be the effect if they install too much capacity, is what changes the nature of the game when played in stages and when we study subgame-perfect equilibria.
  - Both firms would of course like to have a lot of capacity and sell that at a high price, but they realize that once they reach the second stage, they will compete away those profits if there is sufficient capacity to service the entire market at low prices. That is a "credible threat". Thus, they both realize that they will be better off if they restrict their capacities in stage 1, thereby raising the second-stage price and the profits. The SPE therefore entails positive profits, in contrast to the Bertrand equilibrium.
  - The two-stage nature of the game will not eliminate all of the competitive pressure, however. We demonstrated that with efficient rationing and constant marginal cost, we end up with the Cournot outcome as the SPE. The firms would therefore collectively be better off if they had been able to restrict their capacities further, but if they did, they would both have incentives to increase their capacity again.

Question 3 – monopolistic pricing

A monopolist firm faces a linear demand curve given by P = 100 - Q, where P is the price and Q is the quantity demanded. The firm's marginal cost is constant at $20 per unit. Determine the optimal profit the firm can obtain under

a. uniform pricing and
b. perfect price discrimination.

Answer

- **Uniform Pricing**:
  - Calculate MR = MC for profit maximization.
  - MR is derived from the demand curve, R=Q*(100-Q), MR = 100 - 2Q.
  - Set MR equal to MC ($20) to find Q*=40
  - Find P using demand equation at Q*, P*=60
  - Calculate profit (Π = Revenue - cost). (P*-MC)xQ*=(60-20)x40=1600
- **Perfect Price Discrimination**:
  - With perfect price discrimination, all consumers with wtp above the marginal cost will be served, at a price equal to their willingness to pay
  - $\Pi = \int_0^k (P(Q) - MC)dQ$, where k is determined by $P(Q) = MC \Rightarrow k = 80$
  - $\Pi = \frac{80*80}{2} = 3200$

Question 4 - auctions

In an auction for a single item, there are three bidders with valuations of $100, $80, and $60, respectively. Assume that the bidders are risk-neutral and have independent private valuations.

a. Determine the optimal bidding strategy for each bidder in a second-price sealed-bid auction (Vickrey auction).
b. Who do we expect will end up with the item, and at what price?
c. If the bidders' valuations were common knowledge and this was a first-price auction, who do you expect would have ended up with the item, and at what price?

Answer

- **a) The optimal strategy in a Vickrey auction:**
  - Bid your true valuation
  - If you bid above, you risk paying above your wtp, and only in those cases do you increase the probability of winning
  - If you bid below, you will never pay less than when bidding your true valuation (because price is determined by the others' bids), but you risk losing the object even if you'd be willing to pay more than the resulting price.
- **b) Expected Outcome in Vickrey Auction**:
  - Highest-valuation bidder wins but pays the second-highest bid.
  - $100 valuation bidder wins and pays $80.
- **c) First-Price Auction with Common Knowledge**:
  - Each bidder knows others' valuations, so the $100 valuation bidder needs to bid just above the second-highest valuation.

- The $100 valuation bidder will bid slightly above $80 to win the item; the exact amount could be $80.01 if we assume the smallest bidding increment is $0.01.
- This is analogous to a Bertrand model where costs are common knowledge. Bonus points for the students who draw this analogy to Bertrand.

Question 5 – UPP in mergers

Consider the following expression for the Upward Pricing Pressure test used by competition authorities to screen mergers:

$$e_1 < (p_2 - c_2)\frac{\frac{\partial q_2}{\partial p_1}}{\frac{-\partial q_1}{\partial p_1}},$$

where p_i is the pre-merger price of good i, c_i is the pre-merger marginal cost of producing good i, q_i is the demand for good i and e_i is the reduction in the marginal cost of producing good i due to the merger.

Please explain the terms and why a competition authority might be concerned about a merger if the inequality is satisfied.

Answer

- *The Upward Pricing Pressure (UPP) test is a preliminary screening tool used by competition authorities to assess the potential price effects of a merger without conducting a full merger simulation.*
- e1 represents the efficiency gains from the merger in terms of reduced marginal costs for good 1.
- *pipi* and *cici* are the pre-merger price and marginal cost for good i.
- $\frac{\partial q_2}{\partial p_1}$ is the cross-price effect of demand, indicating how the quantity demanded of good 2 changes with the price of good 1. It reflects how much substitution there is between the two goods from the consumer's perspective.
- $\frac{-\partial q_1}{\partial p_1}$ is the own-price effect of demand for good 1.
- If the inequality is satisfied, it suggests that the merger is likely to lead to a significant price increase for good 1 because the cost savings (e_1) are not sufficient to offset the loss in competition.
- When two firms merge, the competition between them is internalized. The merged firm may not have the same incentive to keep prices low because it no longer competes with the other merging firm for the same customers. This is where the loss in competition occurs.
- The left-hand side tells us by how much a cost efficiency compels the merged firm to reduce the price of good 1.

- The right-hand side measures the incentive to unilaterally raise the price due to the internalized competition. That effect is stronger when
    - The goods are closer substitutes, as measured by the diversion ratio. If the diversion ratio is high, it means that a large portion of the consumers who are lost from good 1 when that price is raised, are recaptured as customers of the merged product 2. When this diversion ratio is zero, the goods are completely independent and the merger has zero anti-competitive effects.
    - The margin on good 2 is high. If the margin on good 2 is low, or negative, there is no benefit to the merged firm of recapturing lost good 1-consumers at good 2, thus the merger doesn't create strong incentive to raise the price of good 1 even if the goods are close substitutes.
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- In summary, a merger that satisfies the UPP inequality could lead to a net increase in prices, as the loss in competition—manifested as the reduced incentive to keep prices competitive—may outweigh any marginal cost reductions due to efficiencies from the merger. This outcome is concerning for competition authorities because it suggests that the merger could reduce consumer welfare by increasing prices, which would not occur if the pre-merger level of competition were maintained.