1. Consider a two-period model of the vertical relationship between an up-stream input supplier and downstream manufacturer. In period 1, the supplier chooses the level of investment $I$ to make in a cost-reducing technology. After investment, the supplier has marginal cost $c(I)$, where the function $c(\cdot)$ is decreasing and convex. Regardless of the investment, the manufacturer values 1 unit (only) of the input at $v = c(0)$. In period 2, the two firms bargaining over the price $p$ at which the input will be sold to the manufacturer.

   a. Assuming that $p$ is determined by the Nash bargaining solution. Solve for $p$ as a function of $I$.

   b. Assume that the upstream firm understands how $p$ will be determined in stage 2, provide the first-order condition characterizing its optimal stage-1 investment.

   c. Provide the first-order condition characterizing the efficient level of investment. How does this compare to the predicted outcome in part b? What explains the difference?

2. Consider a market with an upstream manufacturer of wheels and a down-stream manufacturer of skateboards. Both firms are monopolists. Every skateboard requires four wheels, and the marginal cost to the upstream firm to produce a set of four wheels is $c$. Let $w$ denote the price the upstream firm charges for a set of wheels. Let the cost of all other inputs involved in skateboard production be zero, so that $w$ is the marginal cost for the downstream firm. The inverse demand for skateboards is given by $P(Q) = a - bQ$.

   a. Provide an equation characterizing the downstream firm’s demand for wheels.

   b. What profit will the two firms make when each maximizes profits? How does the sum of their profits compare to what they could obtain if they were vertically integrated? Offer some intuition.

   c. Now suppose that instead of using linear pricing, the upstream firm uses an optimal 2-part tariff. What profit does each firm obtain? Does the ability to use a 2-part tariff reduce the incentive to vertically integrate?

3. Read the short article “Complementarity without Superadditivity” on the class web page. Specialize the model of competing varieties to the case where category A involves video services and category B involves internet service. Consider a market prior to the AT&T-DirecTV merger where video service was offered by DirecTV and Comcast, while internet service was offered by AT&T and Comcast. Thus, prior to the merger, the choices available to the consumer were:
• standalone DTV video
• standalone AT&T internet
• standalone Comcast video
• standalone Comcast internet
• Comcast bundle (video + internet)
• standalone DTV video + standalone AT&T internet
• none of the above (outside good).

Suppose that Comcast sets the price of its bundle equal to the sum of its standalone prices for internet and video services, minus a discount of $\Delta$.

a. Give an intuitive argument that the total quantity sold by DirecTV will be decreasing in the price charged by AT&T for its internet service.

b. Explain why this implies that, all else equal, a merger between AT&T and DirecTV would reduce the Nash equilibrium prices charged by AT&T and DirecTV in a simultaneous price-setting game.

c. How would you expect the merger to affect the equilibrium price of the Comcast bundle? Why?