

Happy-Hour Economics, or How an Increase in Demand Can Produce a Decrease in Price

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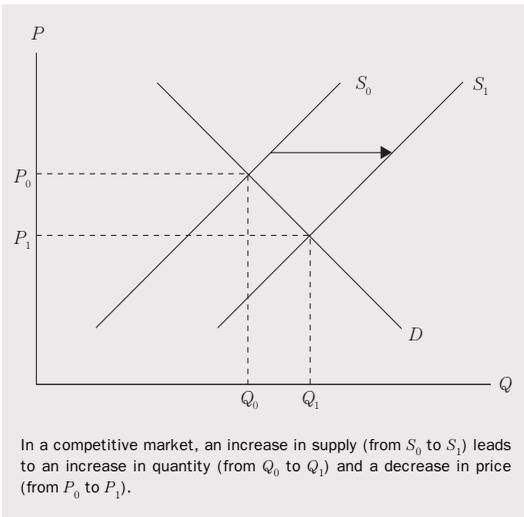
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The framework of supply and demand in a competitive market is an economist's most important tool. It is a powerful engine of analysis, and for many problems it provides the appropriate framework. Used properly, it can bring a wide variety of problems into proper focus. Too often, the novice assumes the simple model of supply and demand in a competitive market is not adequate for analyzing the problem at hand when, in fact, it is.

Nevertheless, in some situations the assumption of a competitive market (along with supply and demand) does not capture the features of interest. Consider the "happy hour" phenomenon: Bars near workplaces are often crowded during a period known as happy hour, when prices of alcoholic beverages are reduced. Making sense of this systematic pattern of low prices combined with high quantities is difficult using the standard competitive model since it requires the supply curve to shift out every day at that time (see Figure 1). However, there is an alternative model that provides an interesting explanation: An increase in demand can produce a decrease in price even though costs do not fall.

The model of monopolistic competition provides the needed analytic framework. In this model many firms each produce a product that is technologically the same as its competitors. Consequently, each has the same costs of production as its competitors (the competitive component). Nevertheless, the product each firm produces is differentiated from those of its competitors, resulting in a falling demand curve (the monopoly component). These seemingly contradictory requirements can be rationalized by assuming the firms are separated in space and that consumers bear costs to travel to the firms.¹ We can think of this as a model of *local monopoly*. The firm at a given location has some monopoly power because the nearby consumers would have to pay an extra cost to shop from a competitor farther away. A consumer may be willing to pay a higher price for the convenience of shopping at a nearby store. Of course, if the consumer plans to make a large purchase, it may pay to travel farther to a store with a lower price.

Figure 1
The Standard Competitive Supply-Demand Model



From the perspective of a given firm, the willingness of consumers intending to make larger purchases to travel farther cuts both ways. Not only are nearby consumers more willing to go elsewhere, but faraway consumers are simultaneously more willing to come to the given firm to take advantage of the price it charges relative to its competitors. Thus, when consumers' demand increases, the demand curve facing a local monopolist becomes more elastic—more sensitive to changes in its own price. This increase in elasticity in turn can cause the equilibrium price to be lower during periods of high demand. (Whether or not the price falls will depend on how rapidly production costs rise.)

This article describes a step-by-step construction of a model of monopolistic

competition. The readers who will best understand the exposition are those who have been previously exposed to the theory of monopoly in an undergraduate course on price theory (microeconomics) in which calculus was used to compute slopes and find maxima. Also, some familiarity with basic probability theory will be helpful in understanding the discussion of the search-cost model.

The discussion focuses first on the distinction between price takers and price setters and then provides a review of the theory of profit maximization for a monopolist. The analysis is then extended from a monopoly to monopolistic competition (in the form of a local monopoly). The notion of a Nash equilibrium is introduced, and two examples are provided: a travel-cost example and a search-cost example.

Price Takers and Setters

In a competitive market, firms and consumers are *price takers*. Price takers make their decisions based on the assumption that their behavior has no effect on the market price: They take the market price as given. Firms in a competitive market each have *supply curves*: For any given price there is an amount that each firm would wish to sell.² The market supply curve is the sum of all the firm's supply curves at each price. Each consumer has a *demand curve*: For any given price there is an amount a consumer would like to buy.³ The market demand curve is the sum of the individual consumer demands at each price.

Price setters, by contrast, make their decisions based on the assumption that their behavior does in fact affect the market price: They do not take the price as given. For example, when considering whether to increase production and sales, a monopolist should take into account the effect of the additional sales on the market price. In fact, the monopolist can set the profit-maximizing amount to sell by setting the profit-maximizing price. Because a monopolist is a price setter, it does not have a supply curve. The question "If the price were \$5.00, how much would you supply?" has no meaning for a monopolist. A monopolist considers the entire demand curve when deciding what to do.

In a market characterized by monopolistic competition, the demand curve that a firm faces depends on the price charged by its "nearby" competitors. No firm has a

supply curve. However, in this case, it is likely that when consumers' demand increases, the equilibrium price will fall.

Simple Monopoly

The central paradigm in economics is as follows. The rule for determining optimal behavior (the scale of an "activity") is

$$\textit{marginal cost} = \textit{marginal benefit},$$

which can be abbreviated as $MC = MB$.⁴ Unless this equality is satisfied, a better result can be obtained either by doing more or by doing less. If the cost of doing a little bit more is less than the benefit from doing a little bit more (that is, if $MC < MB$), then one will be better off by doing a little bit more. Conversely, if the cost saving from doing a little bit less is greater than the benefit loss from doing a little bit less (that is, if $MC > MB$), then one will be better off by doing a little bit less.

For a firm, the "activity" is its rate of production (or rate of output): It chooses the rate of production that maximizes its profits. In this setting, $MC = MB$ becomes $MC = MR$, where MR stands for *marginal revenue*, which is the additional revenue obtained from producing and selling an additional unit (in terms of rate).

The demand curve shows the quantity demanded, Q , as a function of the market price:

$$Q = D(P).$$

It will be sufficient for our purposes to consider the following linear demand curve:

$$(1) D(P) = a - bP,$$

where $a > 0$ and $b > 0$ are constants. The slope of the demand curve is given by the derivative

$$\frac{dD(P)}{dP}.$$

For the example, $dD(P)/dP = -b < 0$. This negative slope is consistent with the notion that demand curves slope downward.

The demand curve can be reexpressed as the *inverse demand curve*, which gives the price as a function of the quantity:

$$P = G(Q).$$

The inverse demand curve is used in computing marginal revenue, which in turn is used to find the profit-maximizing level of output. Given demand curve (1), the inverse demand curve is

$$(2) G(Q) = a/b - (1/b)Q.$$

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1. Search costs can play a similar role, as we will see.
 2. Each firm's supply curve is given by its marginal cost curve.
 3. Each consumer's demand curve is determined by the consumer's preferences.
 4. A good economist knows when to treat $MC = MB$ as a testable hypothesis and when to treat it as a tautology.

The slope of inverse demand curve (2) is

$$\frac{dG(Q)}{dQ} = -(1/b),$$

which equals the inverse of the slope of the demand curve.

Revenue equals price times quantity: $PQ = G(Q)Q$. Marginal revenue is the additional revenue generated by an additional amount of production/output/sales. In fact,

$$(3) \quad MR := \frac{d(PQ)}{dQ} = \frac{d(G(Q)Q)}{dQ} = G(Q) + \left(\frac{dG(Q)}{dQ} \right) Q.$$

Given the inverse demand curve (2) we have

$$(4) \quad MR = (a/b) - (2/b)Q.$$

In order to maximize profits, the cost of production must be taken into account. Let $C(Q)$ denote the total cost of producing output Q . Marginal cost (MC) is the additional cost resulting from a small increase in output:

$$MC := \frac{dC(Q)}{dQ}.$$

We assume the cost function is given by

$$(5) \quad C(Q) = \alpha + \beta Q + \frac{1}{2} \gamma Q^2,$$

where $\alpha > 0$, $\beta > 0$, and $\gamma \geq 0$ are constants. Then

$$(6) \quad MC = \beta + \gamma Q.$$

A firm's optimal rate of production is characterized by $MC = MR$ or

$$(7) \quad \frac{dC(Q)}{dQ} = G(Q) + \left(\frac{dG(Q)}{dQ} \right) Q.$$

In other words, a firm chooses a rate of production Q^* (rate of output, rate of sales) such that equation (7) is satisfied. If the left-hand side is smaller than the right-hand side, then the firm should increase its output (and vice versa).

Using equations (4) and (6), $MC = MR$ produces

$$\beta + \gamma Q^* = a/b - (2/b)Q^*,$$

which can be solved for the profit-maximizing quantity⁵

$$(8) \quad Q^* = \frac{(a/b) - \beta}{(2/b) + \gamma}.$$

The profit-maximizing price is given by $P^* = G(Q^*)$. The profit-maximizing price can be expressed as

$$(9) \quad P^* = \underbrace{(\beta + \gamma Q^*)}_{MC} + \underbrace{Q^*/b}_{\text{markup}}$$

The firm can now announce this optimal price and end up selling the optimal amount.⁶ See Figure 2 for a graphical illustration.

Local Monopoly

General setup. The phenomenon of high demand and low price will be most evident in markets where demand fluctuates seasonally. In such markets, the cost of entry may be high enough to keep the number of firms from changing with the seasons, so that fluctuations in price will reflect only fluctuations in demand.

There are L consumers, each of whom demands θ units at any price. There are two seasons—a low-demand season and a high-demand season—characterized by the value of θ . There are n technologically identical firms: Each firm’s cost function is given by equation (5). We assume that neither the number of consumers nor the number of firms changes from season to season. Let \tilde{Q} denote the average amount demanded per firm,

$$(10) \quad \tilde{Q} := \theta L / n.$$

In equilibrium, each firm faces the following demand curve:

$$(11) \quad Q = \tilde{Q} \left(1 + \frac{\tilde{P} - P}{\mu} \right),$$

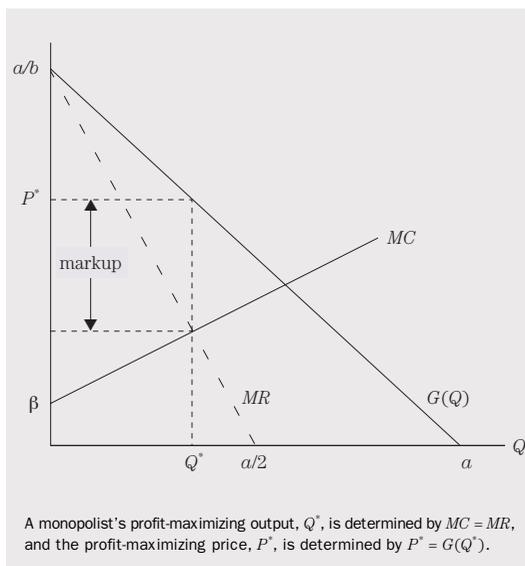
where \tilde{P} is the price charged by all other firms and μ is a parameter that depends on θ (to be made explicit later). Note that the demand curve (11) can be written as $Q = a - bP$, where

$$(12) \quad a = \tilde{Q}(1 + \tilde{P}/\mu) \quad \text{and} \quad b = \tilde{Q}/\mu.$$

Thus, the inverse demand curve is given by equation (2) where a and b are given by equation (12). As before, the firm’s profit-maximizing quantity is Q^* , as given by equation (8), and its profit-maximizing price is $P^* = G(Q^*)$, as given by equation (9).

A Nash equilibrium is a set of strategies for players in a noncooperative game such that no player would be better off switching strategies unless other players

Figure 2
Profit Maximization by a Monopolist



5. In order for equation (8) to make sense, $a/b \geq \beta$ so that $Q^* \geq 0$.

6. Profits are revenues minus costs: $\pi(Q) = G(Q)Q - C(Q)$. If $\pi(Q^*) < 0$, then the monopoly is not profitable.

did.⁷ In the context of monopolistic competition, the players are technologically identical firms and the strategies are the prices each firm charges. In this setting, a (symmetric) Nash equilibrium is characterized by all firms charging the same price, which is the profit-maximizing price for each firm.

In a symmetric Nash equilibrium, all firms charge the same price, \tilde{P} , and each firm sells \tilde{Q} units. The Nash equilibrium requires that

$$P^* = \tilde{P}.$$

Setting $\tilde{P} = G(Q^*)$ and solving for \tilde{P} produces the equilibrium price:

$$(13) \quad \tilde{P} = (\beta + \gamma\tilde{Q}) + \mu.$$

(The parameter μ is seen to be the equilibrium markup.) If all firms charge \tilde{P} as given in equation (13), then no firm will wish to deviate from \tilde{P} as its profit-maximizing price.

The change in the equilibrium price due to an increase in demand is given by differentiating \tilde{P} in equation (13) with respect to the demand parameter θ :

$$(14) \quad \frac{d\tilde{P}}{d\theta} = \gamma \frac{d\tilde{Q}}{d\theta} + \frac{d\mu}{d\theta} = \gamma(L/n) + \frac{d\mu}{d\theta}.$$

The equilibrium price will fall with an increase in demand if $d\tilde{P}/d\theta < 0$, which is equivalent to

$$\gamma < -(n/L) \frac{d\mu}{d\theta}.$$

For example, if $\gamma = 0$ and $d\mu/d\theta < 0$, then the equilibrium price will fall when demand increases.⁸

All that remains is to specify how the markup coefficient μ depends on consumer demand θ . In the two models of local monopoly presented below, the markup decreases when demand increases.

Local monopoly with travel costs. Identical firms are located along a road, n per mile.⁹ Consumers are continuously distributed, L per mile, and can travel to firms at a cost of c per mile. Assume that each consumer inelastically demands θ units; that is, each consumer will purchase θ units—no more, no less—at any price. (The average demand per mile is θL ; the average demand per firm is $\theta L/n$.)

For a consumer located m miles from a firm charging price P , the full cost of θ units is $\theta P + mc$. The term mc represents a fixed cost for the consumer. The cost per unit demanded is $(\theta P + mc)/\theta = P + m(c/\theta)$. If the consumer's demand increases, then the cost per unit declines. A consumer will patronize the firm for which the full cost is lowest and will travel to a more distant firm if the saving on price compensates for the extra travel cost. Hence, if θ increases, the consumer will be willing to travel farther.

A firm charging P whose competitors on either side charge \tilde{P} gets the patronage of all consumers up to m miles away, where m solves

$$(15) \quad \theta P + mc = \theta \tilde{P} + (1/n - m)c.$$

The Elasticity of Demand

The *elasticity of demand* is the percentage change in the quantity demanded given a 1 percent increase in the price. The elasticity of demand measures the sensitivity of the quantity demanded to the price in a way that is free of units of measurement. Let η denote the elasticity of demand. It can be computed as follows:

$$\eta = \frac{dD(P)}{dP} \div \frac{D(P)}{P}.$$

Since the slope of the demand curve is negative, the elasticity of demand is also negative,

$\eta < 0$. Demand is said to be *inelastic* when $|\eta| < 1$, *unit elastic* when $|\eta| = 1$, and *elastic* when $|\eta| > 1$. When the absolute value of η increases, demand has become more elastic.

For demand curve (11), the elasticity of demand at the equilibrium price is

$$\eta = -\tilde{P}/\mu.$$

In the models of local monopoly, as demand increases, μ decreases, and consequently demand becomes more elastic.

The left-hand side of equation (15) is the cost to buy from the given firm while the right-hand side is the cost to buy from the nearest competitors on either side. The firm sells a total of

$$(16) \quad Q = 2m\theta L$$

units. To find the demand curve, solve equation (15) for

$$m = \frac{1}{2} \left(\frac{1}{n} + \frac{\theta(\tilde{P} - P)}{c} \right)$$

and substitute this expression for m into equation (16). The result is a demand curve, which can be written in the form of equation (11) where

$$\mu = c/(\theta n).$$

In this model,

$$\frac{d\mu}{d\theta} = -c/(\theta^2 n) < 0.$$

Local monopoly with search costs. The expected benefit to a consumer from searching, as Stigler (1961) pointed out, is positively related to the amount the

7. See, for example, Nash (1951). For a biography of Nash, see Nasar (2001).

8. There are two reasons why marginal cost might be fairly flat. First, storage may attenuate increases in marginal cost. Firms may be able to produce at a nearly constant rate across the seasons, building up and running down inventories. Second, as Stigler (1939) discusses, there is “the possibility of building flexibility of operation into the plant, so that it will be passably efficient over the range of probable outputs.” In other words, owners may choose an average cost curve that has a higher minimum if it is flatter. And flatter average cost curves make for flatter marginal cost curves.

9. A graphical exposition of the model in this example can be found in the chapter on monopolistic competition in McCloskey (1985).

consumer plans to spend. It makes sense to search more for a new car than for a new pencil. The relationship between expenditure and search holds for any particular good as well. It makes sense to search more for a case of whiskey than for a single pint.

There are L consumers and n firms.¹⁰ Each firm produces a single brand. Consumers must undertake a search to discover the value of each brand. A consumer searches by first choosing a firm at random and then finding the value of the brand, which is itself a random draw from the uniform distribution on the unit interval.¹¹ Let v_i denote the random value (that is, the utility) the consumer gets from one unit of brand i , and let P_i denote the price per unit of brand i . The *net utility* a consumer obtains from purchasing a single unit of brand i is $v_i - P_i$, where P_i is subtracted to account for the utility cost of not consuming other goods. The amount of searching a consumer is willing to undertake is limited by the cost of the search—it costs c to sample a brand and learn its value and its price.

Before we can derive the firm’s demand curve, we need to understand the search behavior of consumers. Accounting for the search costs and the quantity demanded, the net utility gain for θ units after s searches is

$$\Delta := \theta(v_i - P_i) - sc,$$

where $v_i - P_i$ is the maximum value across sampled brands. The consumer’s problem is to maximize the expected net utility,

$$(17) \quad x_0 + E[\Delta],$$

where x_0 is the endowed amount of the numeraire good. If $E[\Delta] < 0$, the consumer may choose not to search, in which case the net utility is simply x_0 .

Suppose the consumer expects all firms to charge \tilde{P} . Consider the following *stopping rule*: Pick a *reservation value*, w , and stop searching as soon as $v_i \geq w$. The probability of obtaining $v_i \geq w$ from a single search is $1 - w$. Therefore, the average number of searches it takes to obtain $v_i \geq w$ is $(1 - w)^{-1}$.¹² The average value of v_i conditional on $v_i \geq w$ is $(1 + w)/2$. The expected utility gain produced by this stopping rule is

$$(18) \quad E[\Delta] = \theta(E[v_i] - \tilde{P}) - E[s]c,$$

where

$$E[v_i] = \frac{1+w}{2} \quad \text{and} \quad E[s] = \frac{1}{1-w}.$$

The best choice of w is the one that maximizes the expected gain. The change in the expected gain due to a small change in w is

$$\frac{dE[\Delta]}{dw} = \underbrace{\theta/2}_{MB} - \underbrace{\frac{c}{(1-w)^2}}_{MC}.$$

A higher reservation wage produces a higher value once one stops searching (*MB*) but requires more searches on average (*MC*). We can set $MB = MC$ by solving $dE[\Delta]/dw = 0$ for the optimal reservation value:¹³

$$(19) \quad w^* = 1 - \sqrt{2c/\theta}.$$

Substituting equation (19) into equations (18) and (17), the maximized value of expected utility is

$$x_0 + E[\Delta] = x_0 + \theta(w^* - \tilde{P}).$$

As long as $w^* > \tilde{P}$, $E[\Delta] > 0$ (that is, the expected net benefit to search is indeed positive).¹⁴

Now we turn to deriving the firm’s demand curve. Note that the stopping condition $v_i \geq w^*$ can be written in terms of the net value for the brand: $v_i - \tilde{P} \geq w^* - \tilde{P}$. This relation suggests that a firm can improve the chances that a consumer buys its brand by lowering its own price, P , relative to its competitors’ price, \tilde{P} . When

$$v_i - P \geq w^* - \tilde{P},$$

a consumer who expects all other firms to continue to charge \tilde{P} will stop searching because the net gain for this brand, $v_i - P$, meets or exceeds the minimum acceptable net gain, $w^* - \tilde{P}$. The stop-searching condition can be written $v_i \geq w^* - P - \tilde{P}$. Thus the probability that a consumer buys a particular brand is $1 - (w^* + P - \tilde{P})$, a decreasing function of P . The expected demand curve facing the representative brand is

$$(20) \quad Q = \theta \left(\frac{L/n}{1 - w^*} \right) [1 - (w^* + P - \tilde{P})].$$

The middle factor on the right-hand side of equation (20) is the expected number of searches per firm, the product of the average number of consumers per firm and the expected number of searches per consumer.

The expected demand curve (20) can be written in the form of equation (11) with

$$\mu = \sqrt{2c/\theta}.$$

In this model,

$$\frac{d\mu}{d\theta} = -\sqrt{c/(2\theta^3)} < 0.$$

Conclusion

In his critique of monopolistic competition, Stigler (1949) argued that “the specific contribution of the theory of monopolistic competition [is] the analysis of the many-firm

10. This model is adapted from Wolinsky (1986). Strictly speaking, the equilibrium presented here is correct only in the limit as L and n go to infinity with L/n fixed. Wolinsky treats the more general case with finite L and n . However, Wolinsky treats only $\theta = 1$.

11. The distribution function is $F(v) = v$, and the density is $f(v) = 1$ for $v \in [0, 1]$.

12. If p is the probability of success and $1 - p$ is the probability of failure, then the probability that the first success occurs on the i th trial is the probability of $i - 1$ failures followed by a success: $(1 - p)^{i-1}p$. The average number of trials until the first success is $\sum_{i=1}^{\infty} i(1 - p)^{i-1}p = 1/p$.

13. For this solution to make sense, $0 \leq c \leq \theta/2$ must be true.

14. Consumers with bad luck are allowed to end up with $x_0 + \Delta < 0$.

industry producing a single (technological) product under uniformity and symmetry conditions, but with a falling demand curve for each firm.” He suggested the theory would not be a useful addition to an economist’s toolbox unless it provided “different or more accurate predictions (as tested by observation) than the theory of competition.” This article shows that monopolistic competition, under Stigler’s conditions, predicts something different—that seasonal increases in demand lead to decreases in price.

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