Synopsis of the second lecture in ECO 5315

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Demand and Production Theory

In ECO 5315, we take the view that the primary goal of managers in profit-oriented organizations is to maximize shareholder value. Since the market value of the firm's shares is equal to the present value of its future expected profits, it is important that managers understand how their decisions affect profits. Demand theory enables managers to better understand the nature of product demand, how to discern consumer demand for goods and services, and how consumer demand affects firm profitability. Production theory provides insights concerning the most profitable way to employ the firm's resources to produce its products.

Demand Theory

Product demand is influenced by exogenous and endogenous factors. Exogenous factors are not directly influenced by managers; e.g., the state of the economy, the rate of inflation, *per capita* income, etc. Endogenous factors are either under managerial control or part of the market environment within which firms compete. Examples of endogenous factors include decisions concerning pricing, advertising, product quality, and distribution of the firm's products *and* the products of its rivals. Depending upon how competitively structured the product market is, managers may have varying degrees of flexibility when it comes to pricing. The two extremes are perfect competition, where firms take prices as given, and monopoly, where there is no competition and firms' production decisions directly influence price. We'll study these questions in greater detail when we cover chapters 6, 7, and 10 in the textbook.

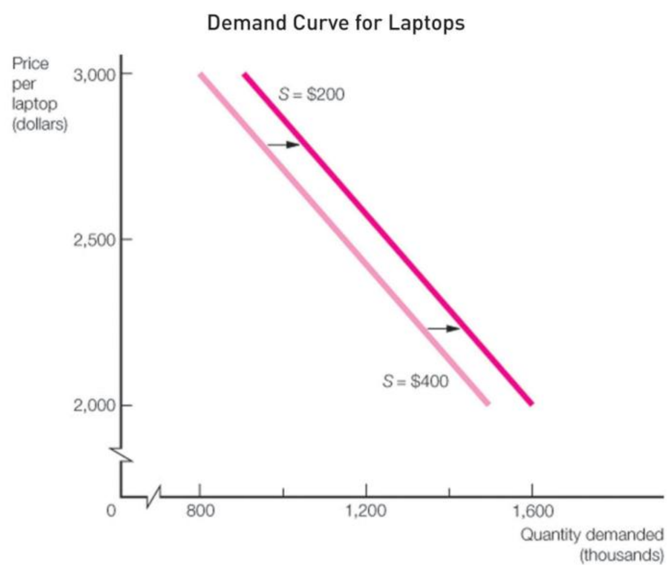
Demand Function

The *demand function* relates the quantity of output (Q) as a function of the various determinants of demand. As a practical matter, firms estimate demand functions using multivariable regression analysis. For example, we used the following demand function to characterize the demand for laptop computers:

$$Q = b_1P + b_2I + b_3S + b_4A,$$

where P = price of laptops, I = *per capita* disposable income, S = average price of software, and A = amount spent on advertising. The predicted signs for the coefficients in this equation are $b_1<0$, $b_2>0$, $b_3>0$, and $b_4>0$; these signs imply that the quantity demanded is inversely related to price, and positively related to income, software prices, and advertising expenses. Furthermore, the beauty of this equation is that the coefficients can be interpreted in a very precise fashion; e.g., b_1 tells us how quantity changes with respect to changes in price, holding income, software prices, and advertising expenses constant. The concept of "holding other things equal or constant" is commonly referred to by the Latin phrase "*ceteris paribus*" (abbreviated as "*cet. par*."), and I will use this "*cet. par*." "shorthand" in the remainder of this synopsis.

The *demand curve* is obtained by plugging in the average values for all right-hand side variables other than price. For example, suppose b_1=-700, b_2=200, b_3=500, and b_4=0.01. Then $Q = –700P + 200(13{,}000) – 500(400) + 0.01(50{,}000{,}000) = 2{,}900{,}000 – 700P$, and the demand curve is therefore written as $P = 4{,}143 – 0.001429Q$. Shifts can occur in the demand curve if the average values for I, S, or A change. For example, suppose the average price of software falls from \$400 to \$200; then $Q = 3{,}000{,}000 – 700P$ and $P = 4{,}286 – 0.001429P$. In this case, since the average price of software (a complementary good) is lower, this increases the demand for laptops, as shown in the following graph:



Elasticity

Elasticity measures how sensitive product demand is to endogenous and exogenous factors. In chapter 2, we study the following set of elasticity measures:

1. *Price elasticity of demand*: $\eta = (P/Q)(dQ/dP)$. Here, η measures how sensitive product demand is to price changes, holding other determinants of demand

(such as income, prices of substitute and complementary goods, etc.) constant. Numerically, $-\infty < \eta \leq 0$. If $\eta < -1$, then the good is *price elastic*; i.e., a 1% change in price results in more than a 1% change in the quantity demanded of the good (in the opposite direction). Price elastic goods (such as homes and automobiles) typically involve large monetary outlays, are durable, and have long lifespans. If $-1 < \eta \leq 0$, then the good is *price inelastic*. Price inelastic goods (such as food and gasoline) typically involve small monetary outlays, are nondurable, are necessities, and have short lifespans. If $\eta = -\infty$, then the good is *perfectly price elastic*; i.e., a small price change results in a huge quantity effect in the opposite direction. If $\eta = 0$, then the good is *perfectly price inelastic*; i.e., the quantity demanded is not influenced by price changes.

2. *Income elasticity of demand*: $\eta_I = (I/Q)(dQ/dI)$. Here, η_I measures how sensitive product demand is to changes in the level of income, *cet. par*. If $\eta_I > 0$, then the good is a *normal good*; i.e., the quantity demanded is positively related to changes in income. Price elastic goods are also often highly income elastic; e.g., durable goods such as homes and automobiles tend to have relatively large positive (greater than one) income elasticities. On the other hand, if $\eta_I < 0$, then the good is an *inferior good*; i.e., the quantity demanded is inversely related to changes in income. Although most goods have positive income elasticities, examples of goods which have negative income elasticities include inexpensive foods such as spam, bologna, frozen dinners, and canned goods. As incomes rise, consumers typically tend to purchase more expensive, appealing and nutritious food. It is also not uncommon for public forms of transportation to have negative income elasticities; as incomes rise, consumers typically "trade up" to private forms of transportation.

3. *Cross-Price Elasticity of Demand*: $\eta_{xy} = (P_y/Q_x)(dQ_x/dP_y)$. Here, η_{xy} measures how sensitive the demand for good *x* is to changes the price of good *y*, *cet. par*. If $\eta_{xy} > 0$, this implies that good *y* is a *substitute* for good *x*; therefore, if the price of good *y* declines (increases), the demand for good *x* will naturally decline (increase), *cet. par*. On the other hand, if $\eta_{xy} < 0$, this implies that good *y* is a *complement* for good *x*; therefore, if the price of good *y* declines (increases), the demand for good *x* will naturally increase (decline), *cet. par*. In class, we did some numerical examples of how the change in the average price of software increases the demand for laptops, *cet. par*. I also provided a number of examples concerning how high energy prices last year significantly affected various sorts of energy-

related consumer decisions; e.g., methods and modes of transportation, home buying practices, and the demand for online courses.

Total Revenue (*TR*), *Marginal Revenue* (*MR*), *Marginal Cost* (*MC*), *Total Profit* (π), *and Price Elasticity* (η)

Note that $MR = d(PQ)/dQ = P(1 + 1/\eta)$ (see page 16 of lecture 2). Since total revenue (*TR*) is maximized when marginal revenue (*MR*) is equal to zero, this implies that marginal revenue is 1) positive at quantities where demand is price elastic; i.e., when $\eta < -1$, 2) zero at quantities where demand is of unitary elasticity; i.e., when $\eta = -1$, and 3) negative at quantities where demand is price inelastic; i.e., when $\eta > -1$. Furthermore, since marginal revenue (*MR*) is equal to marginal cost (*MC*) when total profit (π) is maximized, this implies that the profit maximizing price is $P = MC/(1 + 1/\eta)$. This latter rule is particularly useful and will be expanded upon later in the course.

As the "Elasticity in Use" section on pp. 42-43 of the textbook points out, it stands to reason that the profit maximizing firm would be interested in not only setting $MR = MC$, but also in equating marginal revenues for products with different demand curves. For example, consider the following thought experiment. Suppose an airline is marketing its services to business and leisure travelers. Although the demand curves for these traveler types differ, the marginal costs are not all that different. Therefore, if the marginal revenue on business fares exceeds the marginal revenue on leisure fares, the airline would optimally switch seats out of the leisure fare category and into the business fare category. Since the cost of moving a person in either fare category is likely to be the same, the airline can increase revenues while leaving costs the same by such a switch. Such a move must increase the airline's bottom line.

Production Theory

During last Thursday's lecture, we introduced production theory. Here, our concern is to determine the most profitable way to employ the firm's resources. Generally, we think about how inputs (capital (*K*) and labor (*L*)) are used to produce an output (*Q*). The *production function* relates the quantity of output (*Q*) as a function of the inputs: $Q = f(L, K)$.

Our initial analysis considered the effect of varying the number of labor inputs (*L*) on output (*Q*) while holding the number of capital inputs (*K*) constant. We calculated both the average product of labor ($AP_L = Q/L$) and the marginal product of labor ($MP_L = dQ/dL$). We found (numerically as well as analytically) that the MP_L curve intersects the AP_L curve when AP_L is at its maximum.

The next (and final step in last Thursday's lecture) was to relax the assumption that capital is fixed and instead allow both the quantity of capital and labor inputs to vary. In terms of a picture, this implies that instead of having product curves (which are two-dimensional), we now have product "surfaces" (which are three-dimensional; e.g., see Figure 4.3 on page 103 of the textbook). In the analysis that we'll start back up with this coming Thursday, we'll be able to simplify our analysis back to two dimensions by developing the concepts of isoquants and isocost curves. This will enable us to answer important question such as how one determines the "optimal" combination of capital and labor inputs. In other words, for a given good, do you want to utilize a capital-intensive or a labor-intensive production technology. We'll also learn about "output elasticity", which measures the percentage change in output per one percent change in the firm's capital and labor inputs. It is also an indicator of whether the firm enjoys increasing, constant, or decreasing returns to scale. These terms will all make a lot more sense once we have gone through examples and problems in which we compute these various measures.