Microeconomics with Ethics

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Chapter 15
Market Adjustments and Supply Tools

In this chapter, several comparative statics exercises are provided to show how changes in exogenous variables will shift either supply or demand and cause an adjustment to a new equilibrium with a new market price and quantity.

This module also discusses these same changes in the long-run after free entry and exit of firms in response to profit is incorporated.

Finally we introduce two additional tools for supply analysis; supply elasticity and producer surplus. and provide some examples of how to numerically determine total market welfare using supply and demand functions.

15.1 Comparative Statics Exercises

Learning Objectives

1. Learn the nature of a comparative statics exercise using a supply and demand model.
2. Learn to distinguish exogenous from endogenous variables in a model.
3. Learn how to analyze the market effects on the endogenous variables from changes in one exogenous variable, ceteris paribus

Exogenous vs. Endogenous Variables

Comparative statics is a term used to describe a kind of experiment conducted with an economic model. As discussed previously in chapter 2, all economic models have a set of assumptions which together can be used to deduce a set of implications. Many of the assumptions in a model take the form of economic variables whose values ultimately affect the outcomes (implications) of the model. The implications themselves often involve the values that some other variables in the model will have based on the assumptions.

For example, in a supply and demand model, we assume that the consumer knows the values of the prices of substitute and complement goods and their own household income as well as all the other variables that were described in Chapter 7 as affecting the demand for a particular good. We also assume that the firms supplying a product know the prices of all of its production inputs and the current state of technology and anything else it needs to know to make its decisions about how much to produce. Consumers and producers use this information to make behavioral choices in the market to maximize their individual utility and firm profit and in doing so will cause the market to realize an equilibrium market price and quantity supplied and demanded. The prices and quantities are the implications of the model.

Economists also have names to distinguish these different types of variables. Variables whose values are determined outside the model itself, and used as inputs into the decisions of the market participants, are called *exogenous variables*. The key exogenous variables in the supply and demand model are the variables affecting the position of the demand function (e.g., price of substitutes, price of complements, etc) and those affecting the position of the supply function (e.g., prices of production inputs, etc).

In contrast, variables whose values are determined in the equilibrium of the model are called *endogenous variables*. In the supply and demand model the key endogenous variables are the equilibrium price and the quantities supplied and demanded. Also, any variables in the model whose values depend on the price or quantity are also endogenous, including firm profit, firm revenue and firm costs.

The exogenous variable values are contained within the assumptions of the model, while the endogenous variable values are the implications.

There are a few more complications worth pointing out about the specification of exogenous and endogenous variables. The supply and demand model is actually a series of models that are connected to each other. In Chapter 7 we discussed the theory of demand and created what could called the demand model. In that version of the model the product price was assumed to be known by the producer who used that info to decide how much to consume, In the demand model alone, the market price is an exogenous variable to the producer and the quantity demanded is the endogenous variable, or implication of the model. The same is true of the theory of supply developed in chapter 14. To a perfectly competitive firm, the price is taken as given, meaning it is assumed to be exogenous. The firm uses that info, along with other information, to decide how much to produce. Thus, in the supply model alone the market price is exogenous while the quantity supplied is endogenous.

Finally, when we put the demand and supply functions together and describe the market model, the market price is now endogenous as is the quantity supplied and demanded. The market model that merges the model of demand with the model of supply is a more complicated model than either supply or demand alone. Economists will often say that the market price has been endogenized by virtue of describing a more complicated process or model. In the market model, it is no longer true that the price is the cause which affects the supply (or demand), the effect. Instead the market supply and demand are themselves also a cause which affects the market price, just as the price affects supply and demand. In other words, causation runs in both directions by virtue of having described a more complicated market process.

This is a long introduction to the idea of comparative statics, but the detour is useful because we can now more easily describe these exercises. A comparative statics exercise begins with a market equilibrium in which a market price and quantity are already determined. Next we assume there is a change in the value of one of the exogenous variables. We assume that all other exogenous variables remain fixed at their original values and will use the Latin term, ceteris paribus, to indicate that fixity. Finally we determine the effects the change in that one exogenous variable will have on the values of the endogenous variables. In this way we can establish cause and effects relationships that can occur while simultaneously maintaining other cause and effect relationships embedded in the complex model. A comparative statics exercise is like a controlled experiment, but instead of conducting it in a laboratory, we conduct it using a system of mathematical relationships. Let's demonstrate with a few examples.

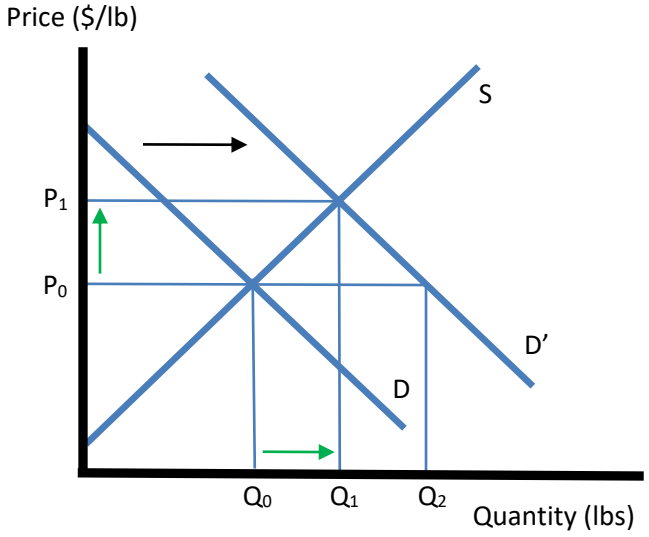
A Change in the Price of a Substitute Good in the Short-Run

Consider a market for a common household good such as butter. Suppose the market is perfectly competitive and can be described by a supply and demand curve as depicted in Figure 15.1. Suppose that the market is in a short-run equilibrium initially with the supply curve S and the demand curve D at the price P_0 and quantity Q_0.

Next suppose there is an increase in the price of margarine, a substitute for butter for many people, ceteris paribus. The ceteris paribus term is put at the end as a reminder that we will assume no other exogenous variable is changing in value at the same time. Because the price of a substitute product is positively related to the quantity of producer demand for butter, we know from chapter 7 that the demand curve shifts to the right, let's assume the shift is to the position given by the demand curve D' in Figure 15.1 (see the black arrow).

Before the price begins to change, demand for butter will rise to the level Q_2 but supply will remain at Q_0 causing excess demand for the butter. We can now invoke the "price too low" equilibrium story from Chapter 14 to explain how the market price will adjust upward to its new equilibrium value at P_1 (see the vertical green arrow). Demand and supply will rise to Q_1 (horizontal green arrow) as the quantity demanded falls from Q_2 to Q_1 and the quantity supplied rises from Q_0 to Q_1.

Figure 15.1 Effects of a Price Increase in a Substitute Good in the Short-Run



In summary, the supply and demand model predicts that an increase in the price of a substitute good for a product, ceteris paribus, will cause the market price of the product to increase and the quantity supplied and demanded to increase in the short-run.

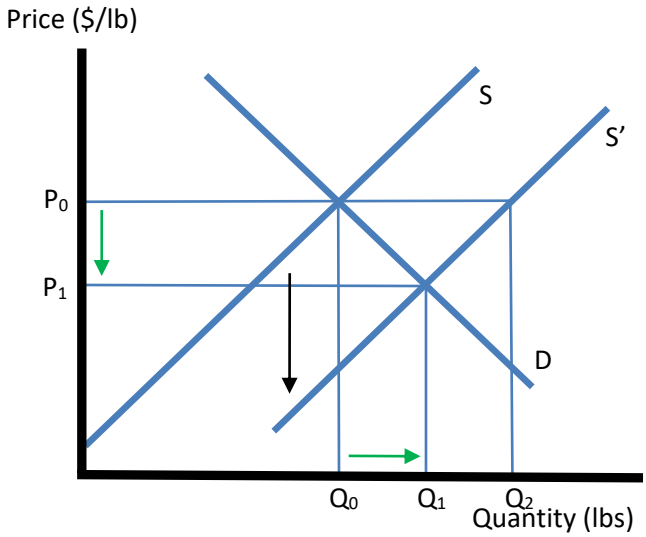
A Change in a Production Input Price in the Short-Run

Again consider the market for a common household good such as butter. Suppose the market is perfectly competitive and can be described by a supply and demand curve as depicted in Figure 15.2. Suppose that the market is in a short-run equilibrium initially with the supply curve S and the demand curve D at the price P_0 and quantity Q_0.

Next suppose there is a decrease in the price of milk, an input used to produce butter, ceteris paribus. Because an input price is negatively related to the quantity supplied of butter, we know from chapter 14 that the supply curve shifts to the right (or equivalently downward reflecting the reduced costs of production). Let's assume supply shifts to the position given by the supply curve S' in Figure 15.2 (see the black arrow).

Before the price begins to change, the supply of butter will rise to the level Q_2 but demand will remain at Q_0 causing excess supply for the butter. We can now invoke the "price too high" equilibrium story from Chapter 14 to explain how the market price will adjust downward to its new equilibrium value at P_1 (see the vertical green arrow). Demand and supply will rise to Q_1 (horizontal green arrow) as the quantity supplied falls from Q_2 to Q_1 and the quantity demanded rises from Q_0 to Q_1.

Figure 15.2 Effects of a Decrease in Input Prices in the Short-Run



In summary, the supply and demand model predicts that a decrease in the price of an input used in production, ceteris paribus, will cause the market price of the good to decrease and the quantity supplied and demanded to increase in the short-run.

A Change in the Price of a Substitute Good in the Long-Run

Next let's consider the effects of the same two changes as above but in the long-run rather than the short-run.

So again, consider a market for a common household good such as butter. Suppose the market is perfectly competitive and can be described by a supply and demand curve as depicted in Figure 15.3. Rather than depicting the upward-sloping short-run supply curve though, now we will use the long-run horizontal supply function set at the minimum average cost of production as derived in Chapter 13. Suppose that the market is in a long-run equilibrium initially with the supply curve S_{LR} and the demand curve D at the price P_0 and quantity Q_0.

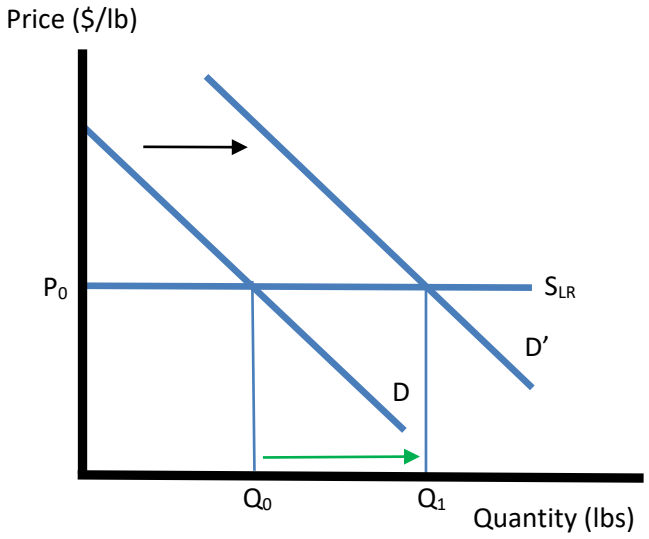
Suppose there is an increase in the price of margarine, a substitute for butter for many people, ceteris paribus. Because the price of a substitute product is positively related to the quantity of

producer demand for butter, we know from chapter 7 that the demand curve shifts to the right, let's assume to the position given by the demand curve D' in Figure 15.3 (see the black arrow).

In the short-run, the price and quantity will both increase as described in the exercise above. However, the price increase will cause firms to make positive profit which in turn will induce entry of new firms in the long-run. Entry will increase total market supply bringing the price down and profit down with it. Eventually the price will settle back at the minimum average cost of production at the original price of the product, P_0. Market demand and supply will rise to Q_1 (horizontal green arrow).

There is one other notable difference between the short-run and the long run. In the short-run the number of firms producing for the market is fixed and exogenous. The ceteris paribus assumption in the short-run scenario included that the number of firms was unchanging. However, in the long-run scenario the number of firms becomes endogenous and therefore the ceteris paribus assumption does not apply to that variable.

Figure 15.3 Effects of a Price Increase in a Substitute Good in the Long-Run



In summary, the supply and demand model predicts that an increase in the price of a substitute good for a product, in the long-run, ceteris paribus, will cause the market price of the product to stay the same, the quantity supplied and demanded in the market to increase, and the number of firms supplying the product to increase.

A Change in a Production Input Price in the Long-Run

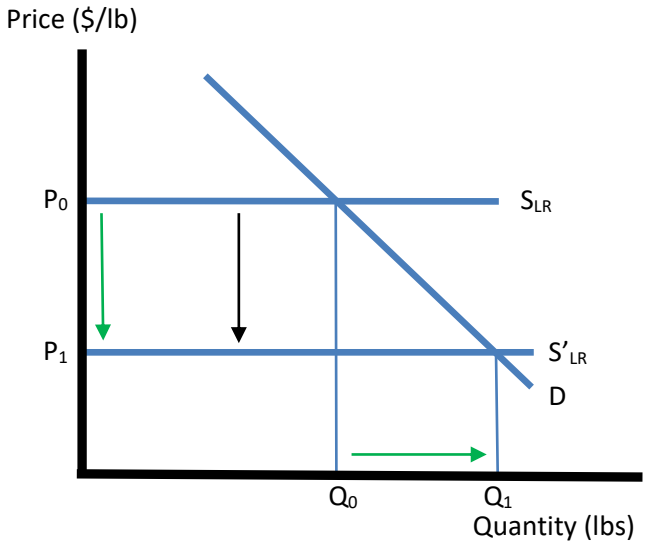
Again consider the market for a common household good such as butter. Suppose the market is perfectly competitive and can be described by a supply and demand curve as depicted in Figure 15.4. Suppose that the market is in a long-run equilibrium initially with the supply curve S_{LR} and the demand curve D at the price P_0 and quantity Q_0. Next suppose there is a decrease in the price of milk, an input used to produce butter, ceteris paribus.

As shown in Chapter 14, a decrease in an input price causes a firm's average and marginal cost curves to shift downward reflecting the lower costs of production. Therefore the long-run

supply curve also shifts downward to the new minimum average cost. Let's assume supply shifts to the position given by the supply curve S'_{LR} in Figure 15.4 (see the black arrow).

In the short-run, the price will decrease and quantity increase as described in the exercise above. However, the resulting short-run equilibrium will cause firms to make positive profit (shown in Chapter 14) which in turn will induce entry of new firms in the long-run. Entry will increase total market supply bringing the price down and profit down with it. Eventually the price will settle at the new minimum average cost of production at P_1 (vertical green arrow). Market demand and supply will rise to Q_1 (horizontal green arrow).

Figure 15.4 Effects of a Decrease in Input Prices in the Long-Run



In summary, the supply and demand model predicts that a decrease in the price of a production input for a product in the long-run, ceteris paribus, will cause the market price of the product to decrease, the quantity supplied and demanded in the market to increase, and the number of firms supplying the product to increase.

A Change in Other Exogenous Variables

The exercises above are just a sample of the changes that could be analyzed using a supply and demand model. There are many exogenous variables that cause shifts in demand or supply and each one of these could be changed, ceteris paribus, and the effects analyzed in the short-run and the long-run. Below is a step-by-step guide to help conduct these exercises, or experiments, using a perfectly competitive supply and demand model.

1. You are likely to be given a variable that will change and you must analyze the effects of that change in the market.
2. Identify whether the variable affects the supply or demand of the product.
    a. Look to the demand-shifters (Figures 7.7 and 7.8) and supply-shifters (Table 14.1) summaries.
3. Be sure to take note whether the variable is rising or falling and in which direction the curve will shift.
4. Take note if the analysis is for the short-run or the long-run
    a. If the SR, use an upward sloping supply function
    b. If the LR, use a horizontal supply function
        i. If the variable affects supply, be sure to note if it causes a shift in the LR supply curve (input prices and technology) or not.
5. Identify the final change in the endogenous variables, price and quantity
6. Identify the change in the endogenous number of firms in the LR.

Key Takeaways

1. An exogenous variable is one whose value is determined external to the model.
2. An endogenous variable is one whose value is determined in the equilibrium in the model.
3. Comparative statics exercises analyze how a change in one exogenous variable, ceteris paribus, affects the values of the endogenous market variables, especially the price and quantity.
4. There are dozens of comparative statics exercises that can be done using a supply and demand model. Several are illustrated above for both short-run and long-run adjustments. Use the guidelines provided to learn how to conduct them on your own.

15.2 Supply Elasticity

Learning Objectives

1. Learn the definition and the methods used to measure the price elasticity of supply
2. Learn how to differentiate elastic supply from inelastic supply

As discussed in Chapter 8 in Demand Tools, sometimes we care to know the magnitudes of the changes in the variables, not just the directions of the changes.. Knowing by how much something changes, is a measure of the sensitivity of the dependent variable to changes in the independent variables, and can also help in predicting the numerical values of the final outcomes. This is why we measure elasticities. Elasticities are unitless measures of sensitivities that can as easily be applied to supply functions as demand functions.

Price Elasticity of Supply

The Price Elasticity of Supply, or PES, measures how much the market supply for a product changes (measured in percentage terms) given a change in the price (also measured in percentage terms). By using percentages, we solve the problem concerning different units of measure.

The percentage change in a variable, say P, can be found using the following formula.

$\%\Delta P = (P2 - P1) / P1 = (\Delta P/P)$

where the greek letter delta (Δ) is synonymous with the phrase "change in," P1 is the initial, or starting, price, and P2 is the ending price. One mnemonic I always use for percentage changes is (New – Old) / Old, where New is the final value of the variable, and Old is the original or starting value of the variable. Note that we can write this in several ways, with the first expression above showing the initial and final values explicitly, and the second expression abbreviating the change in price using the greek letter delta. Note that a percentage change is a unitless value, because both the numerator and the denominator of the expression is measured in, say $/lb, and therefore the ratio cancels the units out.

The price elasticity of supply is defined as the ratio of two percentage changes, with the % change in the quantity supplied (the dependent variable) in the numerator relative to the % change in the price (the independent variable) in the denominator, as shown below.

$$PES = (\Delta Q_S/Q_S) / (\Delta P/P)$$

This expression has a positive value because the slope of the supply function is positive.

The Price Elasticity of Supply measures how sensitive supply is to changes in price. For example, if supply of butter increases by 10% when the price of butter increases by 5%, then the price elasticity of supply = (10/5) = +2. This means that market supply increases two times as much as the price of butter changes, in percentage terms.

Alternatively, if supply of butter were to decrease by 5% after the price of butter decreased by 10% then price elasticity of supply, PES = (-5/-10) = +0.5. This means that the market supply of butter changes by half as much as the price changes, in percentage terms.

Calculating PES along a Market Supply Curve

Just as we did with calculating demand elasticities in Chapter 8, information from a supply curve can be used to derive the PES for a product. The easiest method is to find the values for price and quantity supplied at two separate points on the supply curve, calculate the percentage changes for each variable in moving from one point to the other, and forming the ratio of the percentage changes as in the PES formula above. This causes some problems as discussed in Chapter 8 which we can avoid by using a point-formula method derived using calculus. We'll use the point formula going forward.

The point-formula for the PES can be used whenever one knows the values of price and quantity on a supply curve and the slope of the supply curve at that point. The result is a unitless expression that has the same interpretation as the PES formula presented above. The derivation follows.

Begin with the PES formula from above.

$$PES = (\Delta Q_S/Q_S) / (\Delta P/P)$$

Then rearrange to get,

$$PES = (\Delta Q_S/Q_S) \times (P/\Delta P)$$

Rearrange again to get,

$$PES = (\Delta Q_S * P)/(\Delta P * Q_S)$$

And finally rearrange again to get,

$$PES = (\Delta Q_S/\Delta P)*(P/Q_S)$$

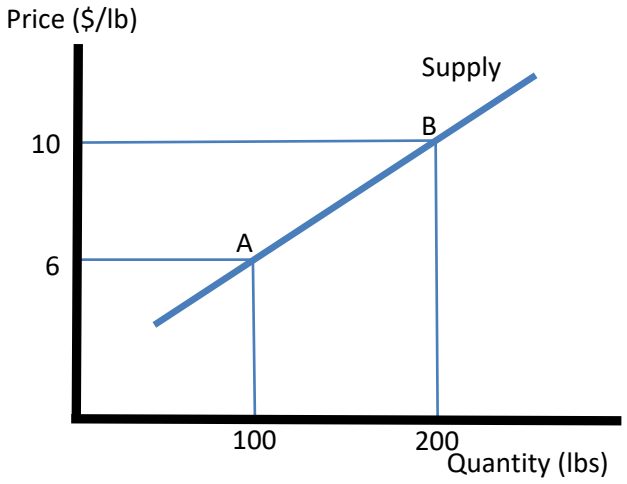
Now, since the slope of a supply curve can be written as $(\Delta P/\Delta Q_S)$ then the expression $(\Delta Q_S/\Delta P)$ in the formula above becomes $1/(\Delta P/\Delta Q_S)$ or (1/slope of supply curve)

Therefore,

$$PES = (1/(\Delta P/\Delta Q_S)) * (P/Q_S) = -(1/\text{slope of supply curve}))*(P/Q_S)$$

Consider the linear supply curve in Figure 15.5. We can calculate the PES at each of the two points labeled A and B.

Figure 15.5 Calculating Elasticities on a Linear Supply curve



PES at Point A = (1/slope of line) x (P/Q_S)

$$= (1/(4/100)) \times (6/100) = (100/4) \times (6/100) = 6/4 = +1.5$$

PES at Point B

$$= (1/(4/100)) \times (10/200) = (100/4) \times (10/200) = 10/8 = +1.25$$

Notice that the PES is not the same at two different points on the same supply curve. However, in the case of a linear supply function that passes through the origin, the PES would be equal to one at all points on the curve, regardless of the slope of the line.

Economists use the following terms to describe PESs that take different values.

If PES > 1 say that supply is ELASTIC

If PES < 1 say that supply is INELASTIC

If PES = 1 say supply is UNIT ELASTIC

If PES = 0 say that supply is PERFECTLY INELASTIC

IF PES = ∞ say that supply is PERFECTLY ELASTIC

Interpretations of PES

The price elasticity of supply is a measure of the sensitivity of market supply to changes in the price of the product. In general, when supply is elastic, it means that supply is very sensitive to changes in price, because supply is affected by a greater percentage than the price change itself (PES > 1). When supply is inelastic, it means that supply is not very sensitive to changes in price, because supply is affected by a lesser percentage than the price change itself (PES < 1).

Products that are supply elastic are those for which fixed costs are low and other entry and exit costs are low. This makes it possible for firms the enter and exit quickly in response to price and profit changes. However, supply tends to be inelastic for products that have a small number of producers where entry and exits costs are high and when the product is naturally in limited or fixed supply, such as with some natural resources.

Crude oil, or petroleum offers a good example of a product whose supply is highly inelastic. It is very costly to explore for and find more petroleum reserves and that makes entry costs high. It can also be very costly to shut down or reduce the output of currently operating petroleum wells. These features make it less likely that firms will change their supplies very much in response to changes in prices, even if those price changes are substantial.

However, time changes everything. If we image a petroleum market measured annually, or perhaps over a five-year period, then greater changes in supply become possible given a price change. When the price of petroleum rises substantially, oil companies do begin further exploration and bring new wells into production over the course of a year or two. Although there are substantial fixed costs and entry costs, these can be spread out over time to make it profitable to produce more. Thus, we can say that while petroleum supply is inelastic in the short-run, over a longer time horizon, petroleum supply becomes much more elastic.

In the supply and demand model we largely ignored the issue of time. The model is often described as a static model to reflect the fact that we typically imagine the market occurs over a short-time horizon like a day or week or month. We do incorporate some elements of time though, as when we talk about moving from the short-run to the long-run in a perfectly competitive model. Recall that the long-run supply function becomes a horizontal line drawn at the level of minimum average cost of production. With regards to elasticities, this means that in the long-run supply is perfectly elastic. This is consistent with the story told above that the passage of time causes a more elastic supply response even when there are adjustment costs to overcome. The long-run supply function ignores the complications caused by adjustment costs and imagines that the final long-run outcome comes about very quickly and perfectly.

Key Takeaways

1. The price elasticity of supply (PES) measures the sensitivity of supply to changes in the price of the good.
2. The basic definition of PES is the percentage change in the quantity supplied divided by the percentage change in the price of the product.

3. The formula for the price elasticity of supply at a point on a supply curve is PES = (1/slope of supply curve))*(P/Q_S)
4. A relatively flat supply curve is elastic because supply changes substantially for a given change in price
5. A relatively steep supply curve is inelastic because supply changes little for a given change in price
6. PES for a product tends to be less elastic in the short-run and more elastic in the long-run.

15.3 Producer Surplus

Learning Objectives

1. Learn how to measure and interpret producer surplus
2. Learn how to measure and interpret market welfare

Producer surplus is a very important concept that will be used throughout the rest of the text in the evaluation of market changes and the effects of government policies. One of the questions we will ask over and over again is, are market participants made better-off or worse-off as a result of some change? We care about this because we seek to identify market arrangements that will enhance the welfare of individuals in a community.

Producer surplus is a measure of the welfare of the producers who supply a particular product in a market. It uses information that is depicted on a market supply curve. We introduced the term surplus in Chapter 3 to described the extra value, or happiness, that accrues to Smith and Jones when they trade oranges for apples. Recall, that mutually voluntary trade occurs only if both individuals expect to realize an improvement in their utility. This was represented diagrammatically as a movement onto a higher indifference curve for each of them. If we imagine that the market exchange is a sale of an item in exchange for money between a consumer and a producer of a product, then just like with Smith and Jones, we expect both parties to the trade will receive some surplus. The amount accruing to the consumer of the good is labeled consumer surplus and its measurement was derived in Chapter 8. Here we will illustrate how to measure the surplus value that accrues to the firms, or suppliers of the goods to the market.

Producer surplus is found by thinking hard about what a supply curve tells us. Consider the supply curve for, let's say, coffee in Figure 15.6 with some very simple numerical values. The demand curve is drawn as a short line to deemphasize its importance in this exercise. Nevertheless where it crosses the supply function determines the equilibrium market price of $10 per pound. Since at the price $10, 200 pounds of coffee is traded in the market, the total revenue earned by firms in the market is given by,

$$TR = P \times Q = (10)(200) = \$2{,}000$$

Note that this is the total revenue earned by all of the firms producing in the competitive market combined.

Next, recall from Chapter 12, that the market supply curve is derived as the horizontal summation of the individual firms' marginal cost (MC) curves. Using some more advance

mathematical tools, i.e., some calculus, one can show that the area below the MC curve, from zero output to the output produced for each firm, represents the total variable cost (TVC) of production for that quantity. This implies that the area under the market supply curve represents the total variable costs for all firms in the market.

Side Note: There are two technical details worth noting here for completeness, 1) This derivation is technical and students in this course need not do this derivation, only remember the implication, and 2) This derivation simplifies the problem by ignoring the complication that the market supply curve may be discontinuous at prices below the minimum variable cost when production is expected to cease. Instead we assume the market supply function is continuous at all quantities above zero.

Next recall that the total profit earned by a firm can be written as,

$$\pi = TR - TVC - TFC$$

where π represents firm profit, TR is total revenue earned on market sales, TVC is the total variable cost and TFC is total fixed cost. This same equation applies at the aggregate level as well, in which case we reinterpret each variable as industry profits, revenues and costs.

We can rearrange this equation in the follow way,

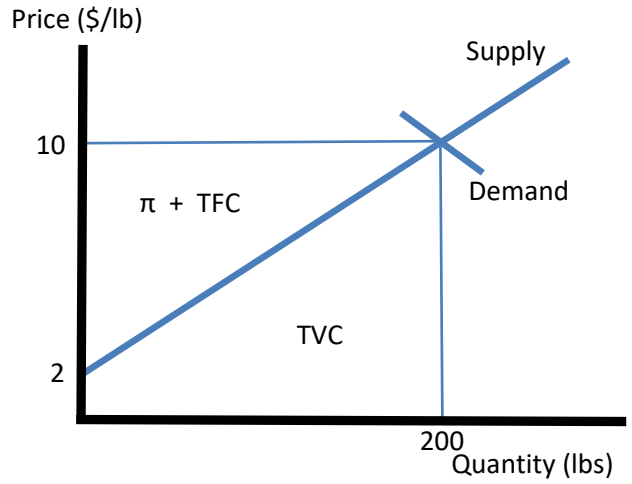
$$TR - TVC = \pi + TFC$$

The left side of the equation corresponds to two separate areas shown in Figure 15.6. Total industry revenue at the equilibrium price of $10, and quantity of 200 pounds of coffee is given by,

$$TR = P \times Q = (10)(200) = \$2{,}000$$

This is the area of the rectangle in the Figure.

Figure 15.6 Calculating Producer Surplus



Total variable cost in the industry is given by the triangular area beneath the supply function. That means that the difference, TR – TVC, is is equal to the area above the supply curve up to

the market price line. In other words the area in the Figure above the supply curve is total market profit plus payments to fixed costs, (π + TFC).

Economists give another name to this triangle; they call it producer surplus. Producer surplus is equivalent to the total market profit and payments to fixed costs. Producer surplus is the standard way to measure the welfare, or well-being, accruing to firms in the marketplace from sales at a particular price and quantity. In a diagram, producer surplus is the area between the supply curve, the horizontal market price line, and the vertical axis.

In Figure 15.6 producer surplus can be easily measured using the equation for the area of the triangle,

$$PS = \tfrac{1}{2}(10 - 2)(200) = \tfrac{1}{2}(8)(200) = \$800$$

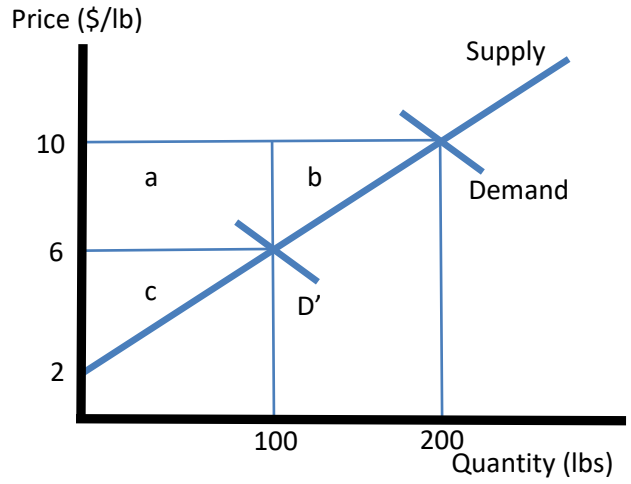
Note that producer surplus has units of dollars. It is best to think of this value simply as the profits accruing to all the firms producing the product. And, since firms are assumed to be maximizing their profit, the larger the value of producer surplus, the happier these firms will be.

A Change in Producer Surplus

A common exercise later in this course will be to assess the effects on producers as a result of some change that occurs. This means that we will sometimes want to know the level of producer surplus in a market as was calculated above, and sometimes we will want to know the change in producer surplus moving between two equilibria.

Consider the change depicted in Figure 15.7 in which demand for the product shifts to the left to D'. This might occur due to a reduction in tastes for the product, or, because the price of a substitute product decreased. The equilibrium price would fall from $10 to $6 per pound and the quantity supplied would fall from 200 to 100 pounds.

Figure 15.7 Changes in Producer Surplus



We have included several variables in the diagram that will allow us to conduct both a conceptual exercise as well as a numerical exercise. The variables a, b, and c in the diagram are meant to represent the areas of the rectangles or triangles in which the variable lies. Thus area a has a height of $4 and a width of 100 pounds so it has the value a = 4(100) = $400.

We can analyze the effect of a reduction in demand conceptually as follows

PS @P=10 = + a + b + c

PS @P=6 = + a

ΔPS = a – (a + b + c) = - b – c

The reduction in demand causes a decrease in producer surplus given by the sum of areas b and c.

Numerically this same exercise becomes,

PS @P=10 = ½ (10 – 2)(200) = $800

PS @P=6 = ½ (6 – 2)(100) = $200

ΔPS = 200 – 800 = - $600

or ΔPS = - (10 – 6)(100) – ½ (10 - 6)(100) = - $400 - $200 = - $600

Measuring Market Welfare in Perfect Competition

Now that we have a measure of surplus for producers, we can add to it the surplus measure for consumers shown in Chapter 8 to derive a measure of market surplus or market welfare. Before doing so it is worth emphasizing that a market for a product depicted in a supply and demand diagram is capturing not just the total quantities traded and the price of the product, it is also representing each and every transaction that occurs between some representative firm and a consumer. Each unit of the good measured along the horizontal axis from the origin out to the total quantity traded is a unit sold by a unique producer from among thousands, and sold to a unique consumer from among hundreds of thousands or millions. Each one of these transactions, or trades, is presumed to be made mutually voluntarily, because both parties expect to receive surplus value in the trade and go home happier than before they came to the market. This outcome will surely occur as long as the assumptions in the model prevail, including the ethical constraints outlined in Chapter 4 requiring there is no theft, fraud or deception.

The measures of producer and consumer surplus provide a method to transform the increases in utility that arise for both parties in a transaction into a common measurement value, namely dollars. These surplus measures also aggregate the surplus values across all of the firms and all the consumers who engage in transactions in the market. This common measurement unit also enables us to add the benefits that accrue to parties on both sides into an overall market value measuring the sum total surplus in the entire market, which we will label market surplus, or equivalently, market welfare.

Consider the market depicted in Figure 15.8 in which supply and demand for a product, say coffee, generates a market price of $8 per pound and a market quantity of 150 pounds. We can use the data presented in the diagram to measure total market producer surplus, total market consumer surplus and total market welfare. Suppose the letters a and b represent the areas of the triangles in which they lie. We thus present a conceptual measurement as well as a numerical measurement of surplus, or welfare in the market.

Conceptually:

CS = +a

PS = +b

MW = + a + b

where CS is total consumer surplus, PS is total producer surplus and MW stands for total market welfare.

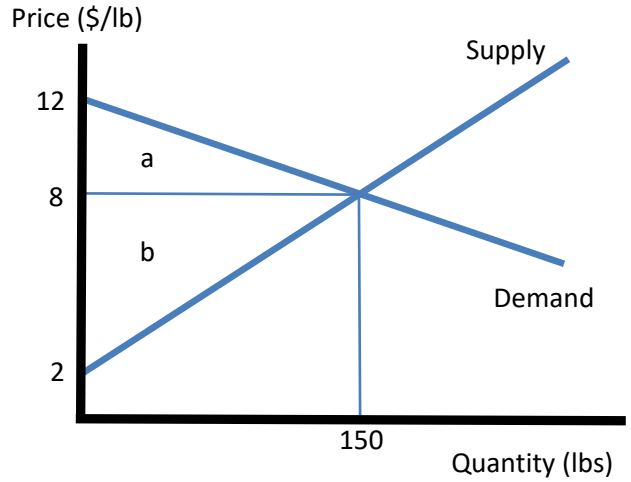
Numerically,

CS = ½ (12 – 8)(150) = $300

PS = ½ (8 – 2)(150) = $450

MW = $300 + $450 = $750

Figure 15.8 Measuring Market Welfare



Side Note: The measure presented here for market welfare is slightly different than the measure we commonly use in macroeconomics. Macroeconomics defines the variable GDP which measures the total value of all final goods and services sold in a national market during a year. We use GDP as a proxy for the success and welfare of an economy. We could say the nation's welfare is approximated with the total value of goods and services the country produces. The market depicted above could represent one of the many markets that are aggregated into the measure of GDP. However, the GDP variable would measure welfare in this market as the value of total revenue because that would be the value of all the transactions for this product. Total revenue in this market is given by the product of the equilibrium price and quantity , or PQ = (8)(150) = $1,200. Notice that this welfare measure is different and higher than our measurement above. Why?

The surplus measure is actually a better measure of how much additional welfare is arising because of production and trade. First, notice that producer surplus is contained within, or is

some fraction of total revenue. The difference is the area below the supply curve which measures total variable costs (TVC). These costs are a burden on individuals because of the hard work and effort expended in the production process. If total revenue were exactly equal to TVC, then producers would earn no surplus, or no extra welfare above the effort it took to produce the goods. The profit they do earn is their reward for producing and trading. Producer surplus represents the extra welfare they obtain when they sell their goods. The consumers on the other side also incur a cost. That is the money they give up, which could have purchased something else instead. They give up their money to acquire extra surplus which is measured as consumer surplus. Thus, the market welfare measured here is a better reflection of the extra value being created that is over and above the cost of producing the goods and services.

One reason this measure is not as commonly used may well be the difficulty of measuring consumer surplus. It's measure requires good knowledge of the full demand functions for all of the goods produced in an economy. This could be done but it is not nearly as easy as measuring the total value of sales. For this reason, total sales revenue across the entire economy, i.e., GDP, provides a reasonably close alternative.

Key Takeaways

1. Producer surplus is equivalent to the sum of industry profits and total fixed costs in production
2. Casually, it is best to interpret producer surplus as simply a measure of total firm profits across the industry.
3. Producer surplus is measured in a diagram as the area between the supply function, the horizontal market price line and the vertical axis.
4. Changes in producer surplus are measured in a diagram as the area between the initial market price, the new market price, the supply curve and the vertical axis.
5. Market welfare is measured as the sum of consumer surplus and producer surplus at the equilibrium market price and quantity.