The Digital Economist

Lecture 3 -- Markets and Equilibrium Analysis

Markets perform the dual role of acting as a rationing system in a world of scarcity and the means by which buyers and sellers of goods and services communicate with each other. The analytical tool used to understand market behavior in known as Supply and Demand analysis.

MARKETS

In models of the market, we define the behavior of **sellers** based on the goal of **profit maximization** in the production and/or sale of a particular good. Higher selling prices allow a trader/seller to reap a gain over and above the price initially paid for a final good or asset. In the case of business firms, the production of additional units of a particular good involve increasing **opportunity costs** in drawing resource inputs away from other productive uses. Higher prices are necessary to cover these increasing costs of production. Thus, these types of behaviors on the selling side of the market typically lead to a positive relationship between **market price** (*the dependent variable*) and **quantity supplied** (*the independent variable*).

> Decisions about production are based on production relationships (the Production Function) which often exhibit Diminishing Marginal Productivity in Short Run production. In this case, additional units of labor input lead to the production of additional units of output (good-**X**) but at a diminishing rate.

> Competition for the factors of production (i.e., Labor) among different uses may be summarized via the *Production Possibilities Frontier* 'PPF' (see Lecture #2). As labor is transferred from the production of some alternative use (i.e., production of good-**Y**) towards good-**X**, *diminishing marginal productivity* requires that more and more of '**Y**' be given up in the production of each additional unit of '**X**'—*Increasing Opportunity Costs*. In dollar terms we find that, in the market, higher prices are necessary to cover these increasing opportunity costs in production. This relationship is behind the derivation of a Individual Producer *Supply curves*.– $Q_s = f_{[+]}(P)$. As we aggregate among all firms in a related industry we derive the Market Supply curve with a similar relationship between price and quantity.

> Supply decisions in the market are driven by higher prices that will induce greater quantities in production

Separately, we define the behavior of **buyers** based on the goal of **maximizing the utility** gained from the purchase and consumption of this same good. As prices fall, holding income constant, the buyer finds that his/her purchasing power has increased allowing for buying greater quantities of a particular good. It is also the case that, for the consumer, additional quantities of a good consumed provide less additional satisfaction relative to previous units consumed. This notion, known as **diminishing marginal utility,** implies that the consumer is willing to pay less for these additional units as it becomes more efficient to use his/her income for the purchase of other goods. For the buyer, these types of behaviors typically lead to a negative relationship between the

market price (*dependent variable*) and **quantity demanded** (another *independent variable*).

> Decisions to Consume: Individual decisions about what to consume and how much to consume are based on the benefits/satisfaction provided by different goods and services. In the case of a particular good, decisions about quantity are based on the benefits of consuming one more unit (the Marginal Benefit 'MB') relative to the price of that good. If the MB of a good exceeds this market price, then the consumer will receive a surplus (consumer surplus) such that the value in consumption exceeds the necessary expenditure for one more unit of that good.
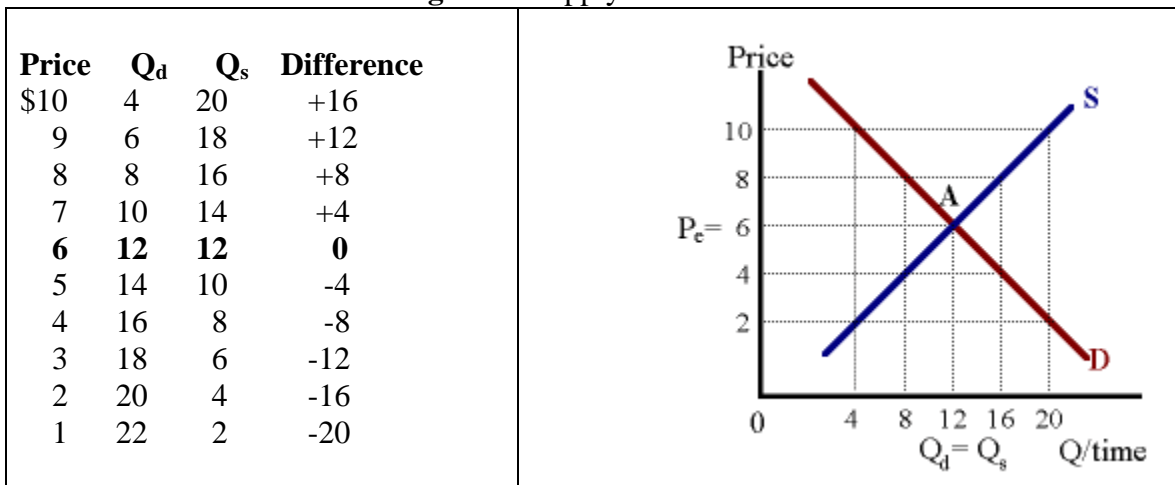
> See: The Digital Economist: http://www.digitaleconomist.com/cs_4010.html

> Additional units consumed provide less additional benefit to the consumer leading to the concept of *Diminishing Marginal Benefit* in consumption. This concept is summarized by an *Individual Demand Curve* 'D_{ind}'. When we sum all individual demand curves of consumers in a particular market we are able to derive the *Market Demand Curve* 'D_{mkt}' such that $Q_d = f_{[-]}(P)$.

> Lower prices are necessary to induce consumers to buy additional units of a good – units that provide less benefit at the margin.

These relationships are demonstrated graphically in Figure 1.

Figure 1: Supply and Demand

Price	Q_d	Q_s	Difference
$10	4	20	+16
9	6	18	+12
8	8	16	+8
7	10	14	+4
6	**12**	**12**	**0**
5	14	10	-4
4	16	8	-8
3	18	6	-12
2	20	4	-16
1	22	2	-20

The Supply and Demand framework represents an analytic tool that assists in the understanding of how markets operate. Each curve represents the separate behavior of the sellers (Supply) and the behavior of buyers (Demand) in a particular market.

In these models, we assume that one unique price exists such that the Quantity Supplied by sellers is exactly equal to the Quantity Demanded by buyers. This unique price P_e is defined to be the **equilibrium price**.

> *This notion of Equilibrium tends to be a rather strong assumption in these economic models.*

In the physical world we often observe equilibrium conditions or situations resulting from the influence of physical laws. For example: a piece of chalk resting on a table is in equilibrium. This situation is the result of the effects of gravity and the existence of a flat and level surface. Gravity helps to maintain and even restore this equilibrium condition if this position of rest is disturbed. In our market models, we need to ask:

> *Where does the gravity come from to establish and maintain an equilibrium price?*

The answer is in the competitive reaction of sellers and buyers to disturbances in the market.

For example, it could be the case that the market price has been forced above equilibrium such that supply decisions by producers with respect to output exceed the amount demanded by consumers. In this case a **surplus** is the result. This surplus is often recognized first by the sellers through the accumulation of inventories.

Figure 2: A Surplus in the Market
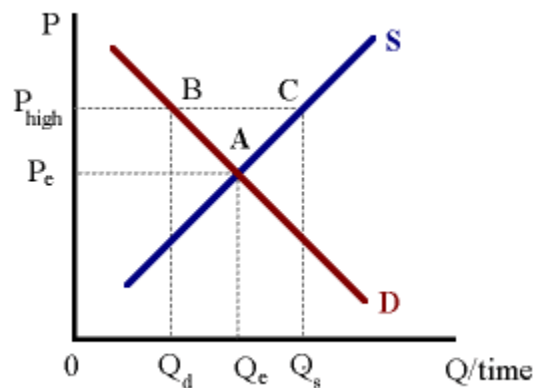
These sellers would react by cutting the price of their product relative to competing sellers (*price-cutting is how sellers compete*) and by reducing the rate of production. Buyers would react to the presence of lower prices by increasing their rate of consumption. This process would be expected to continue until the excess inventories have been eliminated.

Figure 3: A Shortage in the Market
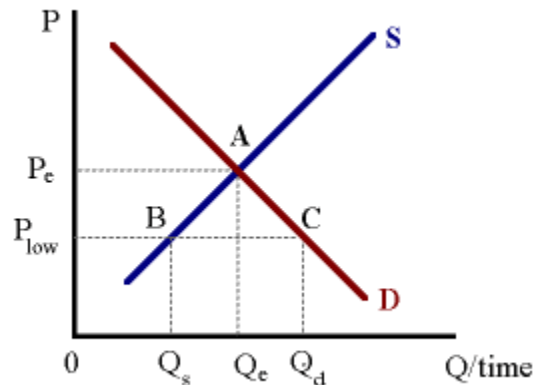
If the market price differed from the equilibrium price such that the quantity demanded exceeded the quantity supplied, a different disequilibrium condition known as a **shortage** would result. Often, but not always, shortages are first recognized by buyers in the form of empty shelves, queuing, and general difficulty in making a desired purchase.

These consumers react by bidding prices up in competition with other buyers (*bidding is how buyers compete*) much like an auction for a single piece of art. As these prices are bid upwards, some buyers drop out of the market reducing the overall rate of consumption. Sellers react to the presence of higher prices by allocating resource inputs from other uses towards production of this particular good.

> *Thus in our models of the market place, **Competition** provides the gravity to maintain or restore the equilibrium price. If surpluses exist, competition among sellers force prices downwards. If shortages exist, competition among buyers force prices upwards.*

In typical market models surpluses are the result of market prices exceeding the equilibrium price such that price-cutting behavior helps restore this equilibrium price. Shortages are the result of market prices taking values below the equilibrium price such that bidding restores the equilibrium price. However, this is not always the case. For example, examine the following diagram:

Figure 4: An Unstable Equilibrium
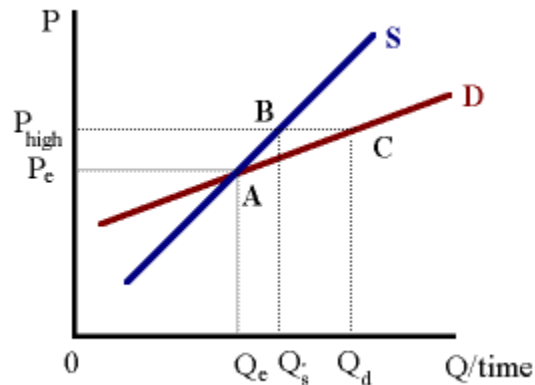
In this example, if the market price exceeds the equilibrium price, a shortage will be the result. This shortage will induce buyers to bid prices further upwards away from the (unstable) equilibrium price. The result will be an eventual collapse of the market as prices approach infinity.

In the above model, the unusual demand curve may be the result of **speculative behavior** by buyers. In this case, individuals are making purchasing decisions not for final consumption of this particular good, but rather in the expectation of resale of the good at an even higher price. As prices are bid upwards, these expectations are confirmed thus leading to further increases in the rate of purchase. Ultimately, prices rise to such a level that expectations of further increases are no longer realistic. At this point in time, the prices that have been inflated by these expectations (much as a bubble expands) collapse. The speculative bubble begins to burst resulting in a collapse in the market.
In reality, surpluses and shortages are caused by changes or shifts in either the demand or supply functions. These shifts are the result of shocks to other (exogenous) variables that affect supply decisions by producers or demand decisions by consumers. Typically, outward shifts in demand will lead to an increase in both the equilibrium price and quantity due to movement along an upward sloping supply curve. Inward shifts of demand will have the opposite effect (a decrease in equilibrium quantity and price). Outward shifts in supply (along a downward sloping demand curve) will lead to an increase in equilibrium quantity and a reduction in equilibrium price.

DEMAND

The demand equation may be written using the following general functional form:

$$Q_d = f(P_x; \text{Income, Preferences, } P_y, \# \text{ of consumers}),$$

where 'P_x' represents the "own" price of the good demanded. The variables listed after the semi-colon represent other exogenous variables that affect the quantity demanded for a particular good. 'P_y' in this list represents the price of a related good (substitutes or complements).

Changes in own price (due to surpluses or shortages) will lead to a movement along the demand curve. In contrast changes in any of the exogenous variables will lead to an inward or outward shift in demand. Any shock that leads to an outward shift in demand (holding the supply of that good constant) will create a shortage of that good at prevailing market prices. This shortage leads to an increase in market prices with corresponding movements along the demand and supply equations until a new equilibrium price and quantity are established.

Figure 5: Market for Personal Computers
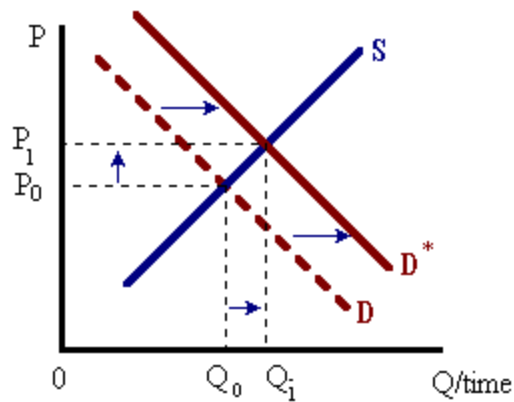
We can examine this type of shock in the diagram above. The market in this example will be for personal computers (assumed to be a normal good). The exogenous shock will be an increase in consumer income. Given this shock, consumers will attempt to purchase more personal computers at each and every price. This reaction will lead to a shortage of this good and thus an increase in the market price. As the market price rises, consumers reduce their rate of consumption (a decrease in quantity demanded) along the new demand schedule and producers increase the rate of production (an increase in quantity supplied).The net result will be an increase of both equilibrium price and quantity.

Shocks that lead to an inward shift will have the opposite effect (creates a surplus which leads to a reduction in market price) as shown in the example below:

Figure 6: Market for Automobiles
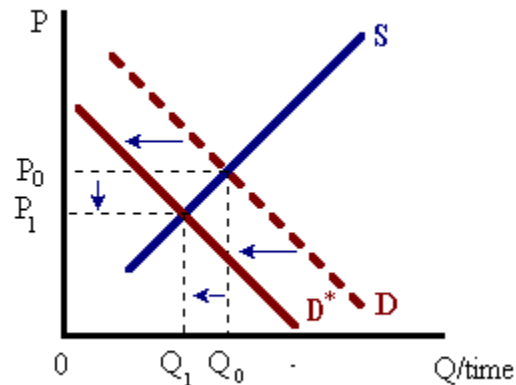
The market in this example will be for automobiles (assumed to be a complement with gasoline. The exogenous shock will be an increase in the price of gasoline. Given this shock, consumers will drive less and begin to purchase fewer autos at each and every price. This reaction will lead to a surplus of this good and thus a decrease in the market price. As the market price falls, consumers increase their rate of consumption (an increase in quantity demanded) along the new demand schedule and producers reduce the rate of production (a reduction in quantity supplied). The net result will be a decrease of both equilibrium price and quantity.

See: The Digital Economist: http://www.digitaleconomist.com/demand.html

SUPPLY

The supply equation may be written using the following general function form:

Q_s = f(P_x; Technology, Factor Prices, Taxes & Subsidies, # of producers),

where 'P_x' represents the "own" price of the good supplied. The variables listed after the semi-colon represent other exogenous variables that affect the quantity supplied for a particular good. Factor prices in this list includes wages, rents, rental cost of capital (interest), and normal profits. Changes in own price (due to surpluses or shortages) will lead to a movement along the supply curve. In contrast changes in any of the exogenous variables will lead to an inward or outward shift in supply. In general, any shock that leads to lower costs of production (technological improvements, lower factor prices, lower taxes, or increased subsidies) will lead to an outward shift in supply (holding the demand of that good constant). This outward shift will create a surplus of that good at prevailing market prices. This surplus leads to a decrease in market prices with corresponding movements along the demand and supply equations until a new equilibrium price and quantity are established.

Figure 7: Market for Cellular Phones
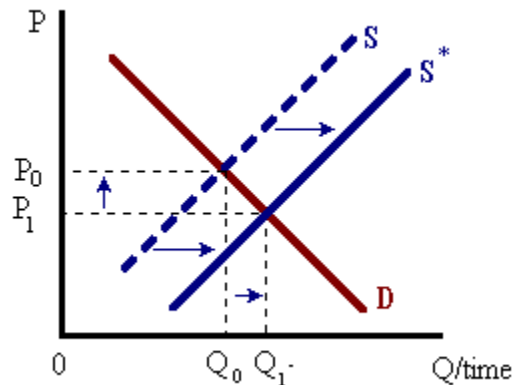
We can examine this type of shock in the diagram above. The market in this example will be for Cell Phones. The exogenous shock will be an improvement in production technology. Given this shock, producers will attempt to produce and sell more Cell Phones at each and every price. This reaction will lead to a surplus of this good and thus a decrease in the market price. As the market price falls, consumers increase their rate of consumption (an increase in quantity demanded) and producers reduce the rate of production (a reduction in quantity supplied) along the new supply schedule. The net result will be an increase of quantity and reduction in equilibrium price. Higher costs of production will have the opposite effect (a shortage leading to higher prices) as shown below:

Figure 8: Market for Housing
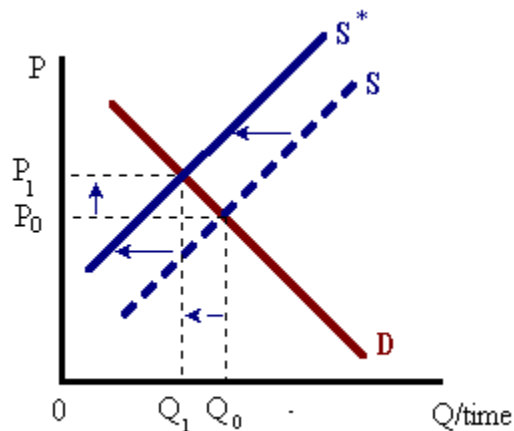
The market in this example will be for Single Family Homes. The exogenous shock will be an increase in the price of land. Given this shock, producers will begin to build and offer for sale fewer new homes at each and every price. This reaction will lead to a shortage of housing and thus an increase in the market price. As the market price increases, consumers decrease their rate of consumption (a decrease in quantity demanded) and producers increase the rate of production (a reduction in quantity supplied) along the new supply schedule. The net result will be a decrease in equilibrium quantity and an increase in equilibrium price.

See: The Digital Economist: http://www.digitaleconomist.com/supply.html

It is possible and common to have exogenous shocks on both sides of the market. Examples would include and increase in consumer income combined with a technological improvement. Is this case, we would expect an outward shift in demand and an outward shift in supply. We would expect an increase in both quantity demanded and quantity supplied and thus an increase in the quantity of the good being traded. However, because there is not a clear indication of whether a surplus or shortage is being created, we are uncertain about the impact on market price.

See: The Digital Economist: http://www.digitaleconomist.com/both_sides.html

---

Be sure that you understand the following concepts and terms:
- Seller/Producer
- Buyer/Consumer
- Profit Maximization
- Increasing Opportunity Costs
- Quantity Supplied
- Supply
- Utility Maximization
- Diminishing Marginal Utility
- Quantity Demanded
- Demand
- Equilibrium Price
- Surplus
- Shortage
- Competition
- Speculation
- Exogenous (Shift) Variables

See Also:
The Digital Economist: http://www.digitaleconomist.com/equilibrium.html
                                                  http://www.digitaleconomist.com/market_tutorial.html

The Digital Economist

Worksheet #3 – Markets

1. Given the following equations representing the behavior of producers and consumers towards the production and sale of blank CD-ROMS (50-packs):

$$\text{Consumers: } Q_d = 120 - 6P$$
$$\text{Producers: } Q_s = 4P$$

Complete the following table:

| Price	Quantity Demanded	Quantity Supplied	Difference
16			
14			
12			
10			
8			
6			
4			
2			
0			

a. What price corresponds to the *equilibrium price* for this market:_____
What is the *equilibrium quantity*?_____

b. Over what range of prices does a *Surplus* result?_____

c. Over what range of prices does a *Shortage* result?_____

d. If a surplus exists, will these prices adjust upwards or downwards?_____

Explain the process by which market prices will adjust? _____

_____

_____

e. What is the *Reservation Price* for this product?_____

Worksheet #3, page2

f. Graph the above price and quantity data and carefully label the Supply curve, Demand curve, Equilibrium Price , and Equilibrium Quantity.

Price

|
|
|
|
|
|
|
|
|
|
|
|
|_____
0   10   20   30   40   50   60   70   80   90
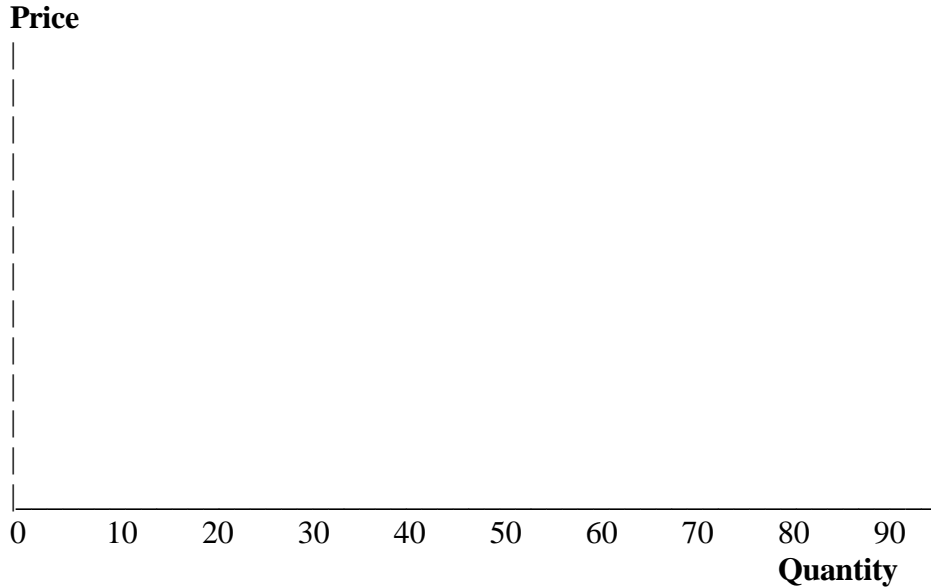
Quantity

2. Use arrows to describe an increase or decrease in equilibrium quantity Q_e and equilibrium price P_e in the middle columns given the "events" described for the following markets. If the resulting impact on price or quantity cannot be determined, use a question mark in place of arrows. In the last column, describe whether the event affects the *supply-side*, the *demand-side* of the market or *both-sides* of the market.

	Market	**Event**	Q_e	P_e	**Supply/ Demand Side**
A.	*Wheat*	A severe drought hits Colorado and other wheat producing states:	____	____	_____
B.	*Personal Computers*	The price of Internet Access is reduced:	____	____	_____
C.	*Autos*	An increase in auto insurance rates <u>and</u> an increase in excise taxes imposed on gasoline:	____	____	_____
D.	*Housing in Boulder*	Zoning laws restrict new construction within the Boulder City limits:	____	____	_____
E.	*Restaurant Meals*	The government mandates a 10% increase in wages and thus incomes:	____	___	_____
F.	*Paperback Novels*	The price of apples doubles	____	____	_____