1. Demand and Supply Basics

We all understand "demand and supply" -- or at least think we do. In reality "demand and supply" is very useful for explaining many concepts. But it can break down where there are great stretches of time, such as investments in public works or durables such as housing.

Demand

When economists talk about, "demand", they can mean two different things, often causing confusion. When they say, "demand is high for iPhones," they mean that at current prices, lots of people are buying iPhones. In other words, they are referring to quantity purchased. On other occasions, they may say "as price rises demand falls." They're really talking about a mathematical function relating quantity purchased to price.

So to avoid confusion here, we will use the term "**demand curve**" for the functional relationship, and "**quantity demanded**" for the amount purchased at a particular price.

All else being equal, the more something costs on the average, the less people will buy. "All else being equal" means, at the least, in the same time and place. (Here already we encounter the spacelessness and timelessness of conventional economics.) We can easily graph this relationship. However, — we owe this upside down convention to the great British economist Alfred Marshall (1842-1924) —we put the independent variable, "quantity" on the x-axis (abscissa) and the dependent variable, "price", on the y-axis (ordinate).

How do we build a demand curve? I'm heading for the Food Emporium with eggs on my shopping list. If the eggs are over three dollars a dozen, I'll only buy one box. But if they're under $2.50 I'll buy two boxes. If the eggs are over four dollars I won't buy any. These points make up my individual demand curve. When 1000 shoppers like me hit the food Emporium on Friday, March 13, the demand curve for eggs is the sum of our individual demand curves. If the price is $2.89 a dozen, we buy 1328 boxes. That's the quantity demanded at that price.

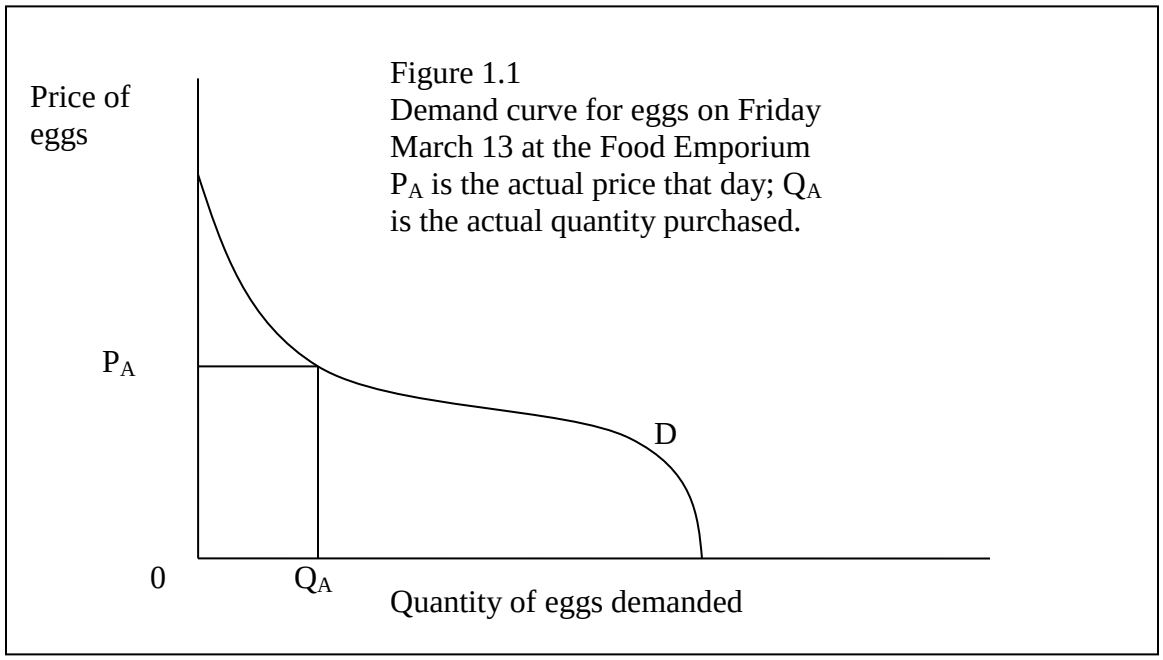


Figure 1.1
Demand curve for eggs on Friday March 13 at the Food Emporium
P_A is the actual price that day; Q_A is the actual quantity purchased.

Figure 1.1 shows the hypothetical demand curve for eggs on Friday March 13 at the Food Emporium, all else being equal. The curve is hypothetical, because we only know one point on it, the price on that day, and the quantity demanded and sold. The curve suggests that above a certain price, no eggs will sell; while even at zero price, customers will take only so many (maybe because there's no more space in the fridge).

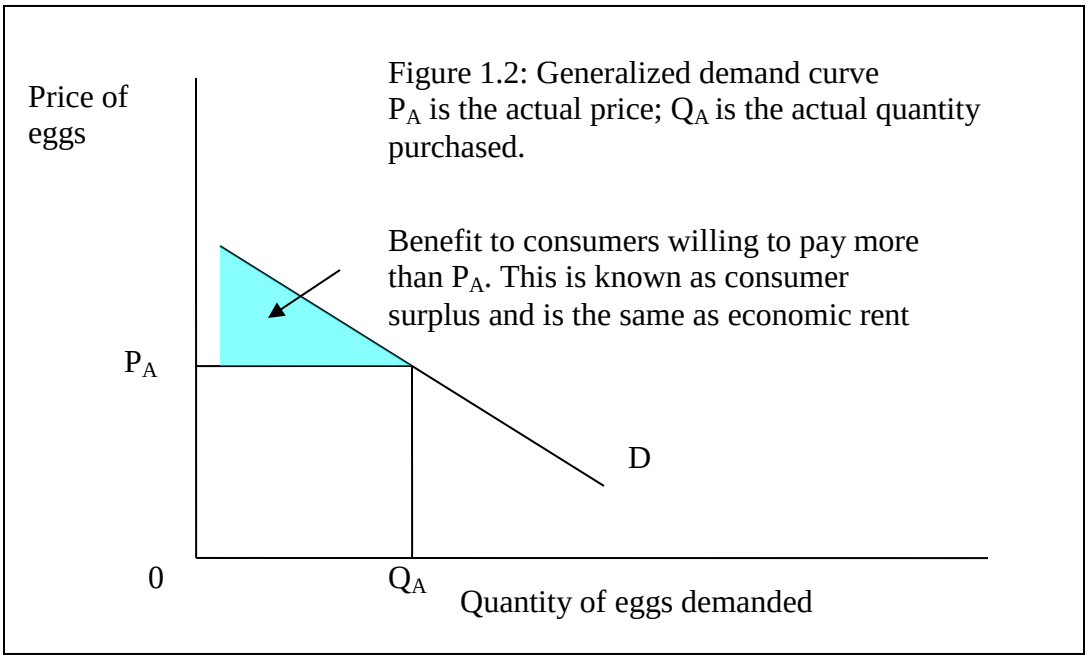


Figure 1.2: Generalized demand curve
P_A is the actual price; Q_A is the actual quantity purchased.

Figure 1.2 shows demand curves the way we usually draw them: a straight downward-sloping line, hanging in space. A straight line will do, because in most instances, we're only considering a small range of prices. What about the **slope** of the line? The flatter the line, the more a small decline in price will produce a large increase in quantity demanded.

Supply

Supply is the obverse of demand. In a barter economy, if I produce eggs and you produce apples, I trade my eggs for your apples. My supply is your demand. In a modern economy, considerable distance and time may separate my eggs from your apples. Money and credit serve to bridge that gap, but that's another topic. As with demand, it's important to distinguish the **quantity supplied** and the **supply curve**—a function relating quantity supplied to price.

How do we derive a supply curve?

Imagine Jill owns the Organic Egg Farm, where she keeps a flock of white leghorn chickens, the best layers. Every day she feeds and waters them, and goes out with her heavy gloves to snatch eggs from under the hens. If the price of eggs doesn't at least cover the feed and transportation to market, she won't even bother to go out and get pecked. As the price gets higher, she starts collecting the eggs; as the price gets even higher, she'll buy more hens. But eventually she'll run into limits. Should she hire a helper? Can she persuade her neighbor to sell her some land so she can expand?

Figure 3 shows a hypothetical supply curve for The Organic Egg Farm. Below a certain price, P_C, the farm produces no eggs. Then the curve is fairly flat for a range where it's easy to expand production. Then the curve steepens, where the farm runs into capacity limits.

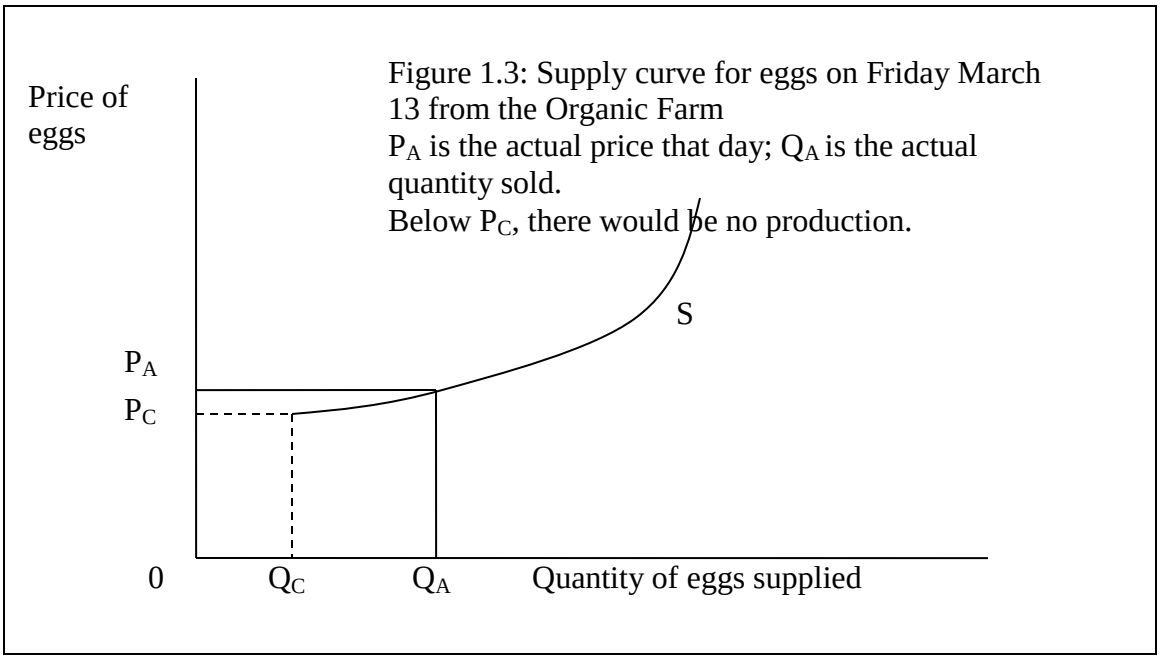


Figure 1.3: Supply curve for eggs on Friday March 13 from the Organic Farm
P_A is the actual price that day; Q_A is the actual quantity sold.
Below P_C, there would be no production.

Figure 1.4 shows a generic supply curve: a straight line sloping upwards to the right. (Remember that quantity is a function of price, not vice versa). The steeper the slope, the less the quantity supplied increases with an increase in slope. If the supply is fixed, like land or many other natural resources, we draw a vertical line for supply.

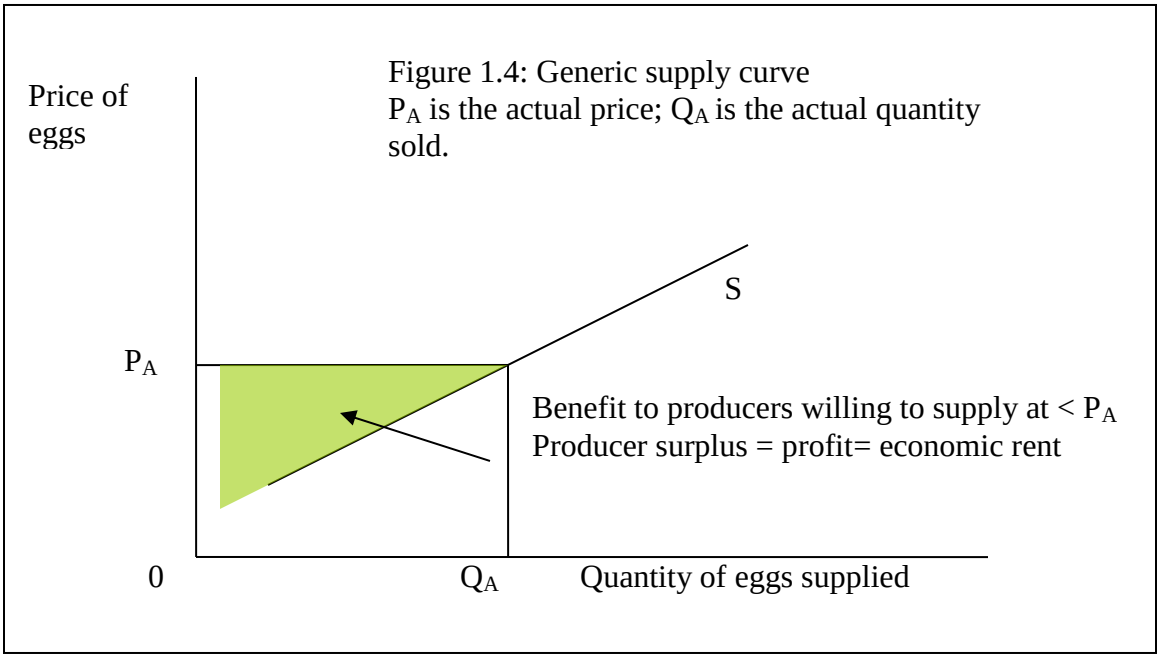
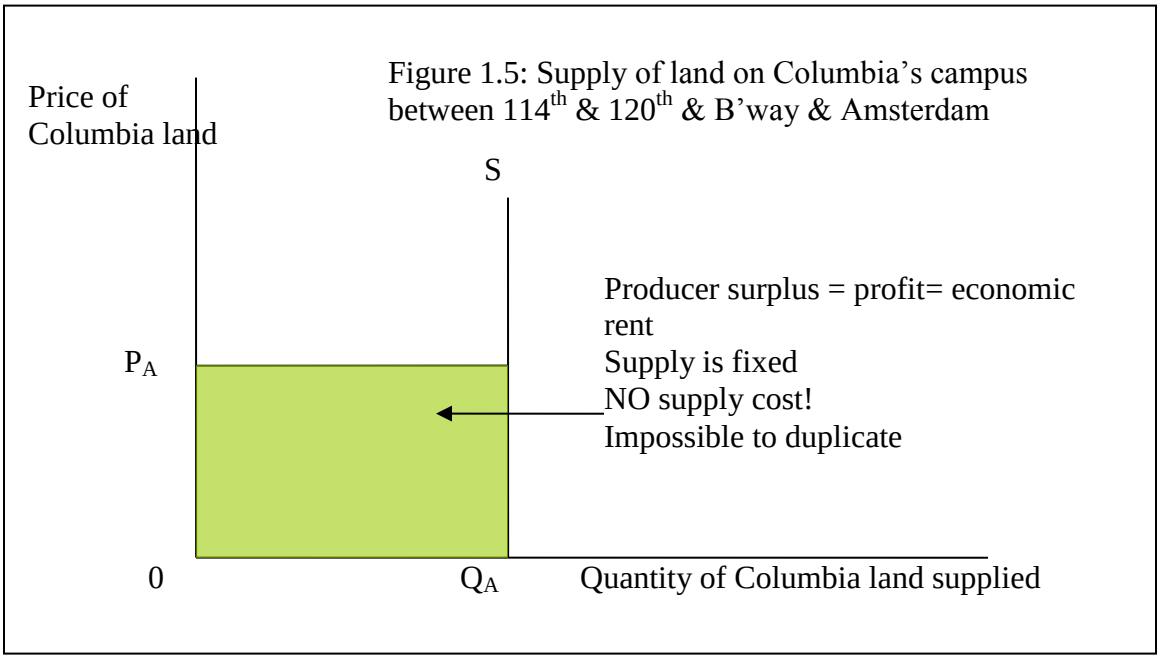


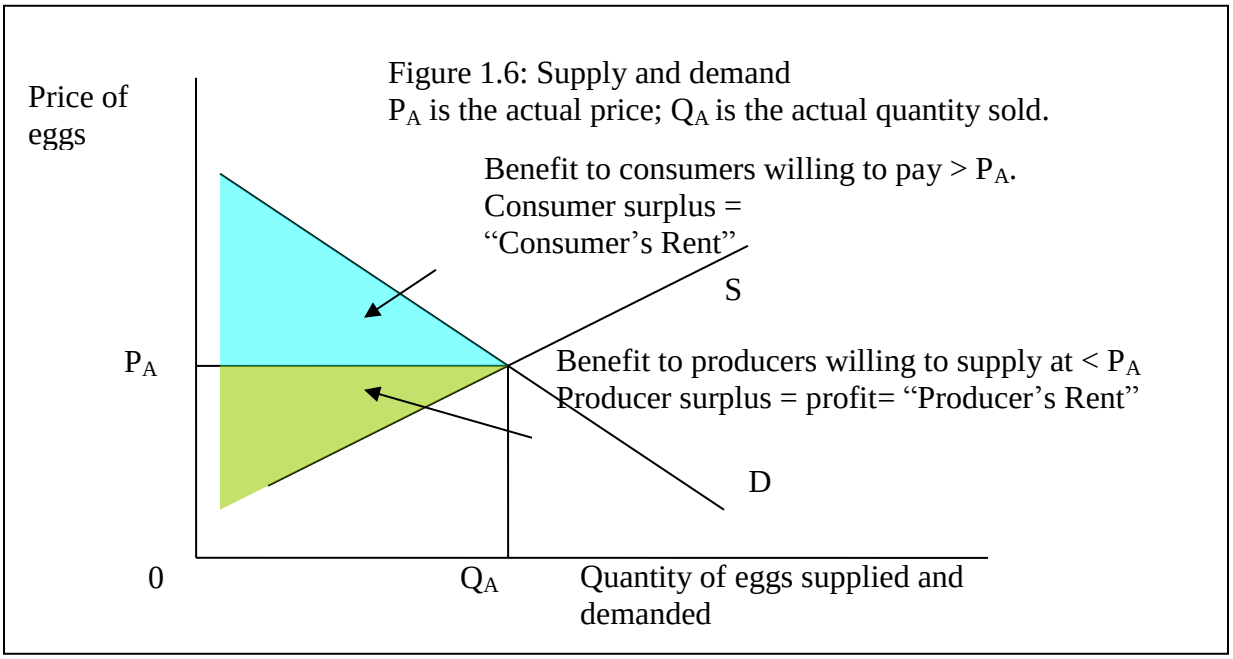
Figure 1.4: Generic supply curve
P_A is the actual price; Q_A is the actual quantity sold.

Figure 1.5 shows a supply curve for land on Columbia's main campus, between 114th and 120th and Broadway and Amsterdam.



Demand and Supply

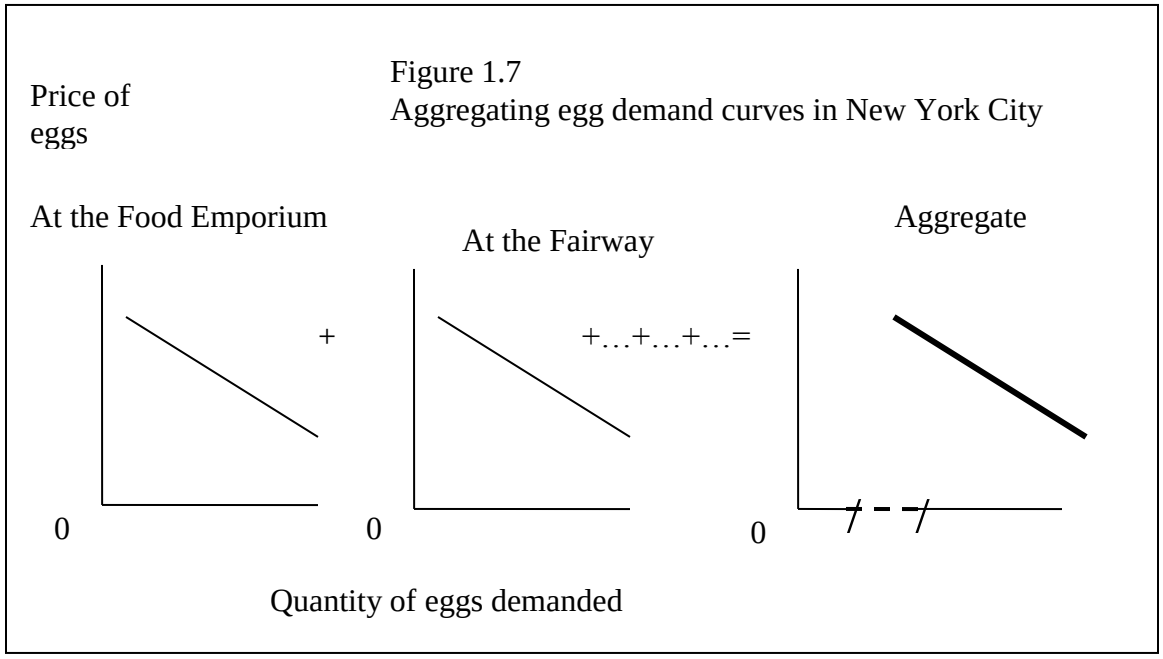
Figure 1.6 is the most familiar of all economic diagrams: In a given market at a given time, the supply curve and the demand curve cross. The crossing point determines the selling price and the quantity sold.



Estimating demand and supply curves. If at any one time and place, there is only one price and quantity sold, that is, the crossing point of demand and supply, how can economists estimate the shape of demand and supply curves? Easy: they compare price and quantity at different times and places. For example, if the Fairway prices eggs low and sells in volume, while next door Citarella prices high and sells more selectively, that gets us two points on a demand curve. Many agricultural prices fluctuate both by time of year and year to year depending on weather. That makes it easy to get multiple data points.

Aggregating demand and supply curves. Economists add up or "aggregate" demand and supply curves. Figure 1.1, the demand curve for eggs on Friday March 13 at the Food Emporium is already the aggregate of the individual demand curves of the customers who did or didn't buy eggs that day. Likewise, the supply curve for eggs at the Food Emporium is the sum of curves of a number of producers. We can aggregate demand and supply curves over space, over time and over products. Figure 1.7 shows the aggregation of egg demand at different stores, added horizontally. We can aggregate demand and supply curves for all sizes and brands of eggs in New York City in March 2008. Or in the entire US in all of 2010.

Figure 1.7
Aggregating egg demand curves in New York City



We can go further. We can aggregate demand and supply for all dairy products, grains, meats and vegetables. We can even aggregate "food." But at each level of aggregation, we move further and further from the ideal of all else being equal. That is, when a demand or supply curve begins to represent a large chunk of the economy, we can no longer assume that it's the mechanical sum of smaller curves. Logicians call this the "fallacy of composition"—the whole does not equal the sum of its parts considered independently. Macroeconomists construct an "aggregate demand curve" and an "aggregate supply curve" for the entire economy; many other economists, myself included, don't consider this a meaningful exercise.

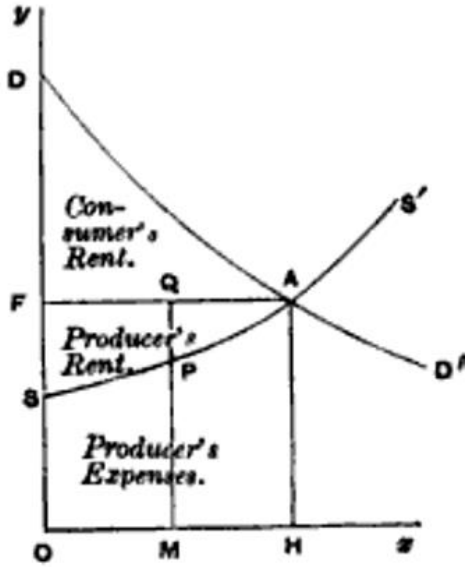
Marginal benefit and marginal cost, consumer and producer surplus; profit, economic rent.

In common sense terms, what does the demand curve actually measure? At each price and quantity, it measures the benefit to purchasers of buying one more unit, one more box of eggs.

The more eggs purchasers already have, the less the benefit of buying more. In economese, a demand curve measures the **marginal benefit** at each price and quantity.

For each price the Food Emporium might set for a box of eggs, there are consumers for whom that's the cutoff price. One penny more and they wouldn't buy. However, most purchasers pay less than they were willing to pay, so they receive a free extra benefit. Economics textbooks call this extra benefit "**consumer surplus**" and represent it by a triangle under the demand curve and above the price. That's the blue triangle above the price line in Figure 1.6.

In mirror image, the supply curve measures **marginal cost**. For each price and quantity, there are producers for whom it's barely worthwhile to produce one more unit. However, at each price, most producers produce most of their units at a lower cost. Textbooks call the difference between price and cost "**producer surplus**." It's represented by the green triangle in Figure 1.6, above the supply curve and under the price line. Where supply is fixed, as in Figure 1.5, Columbia land, producer surplus forms a rectangle.*



Both consumer and producer surplus represent **gains from trade**. Buyers and sellers are both better off by trading; they both get something for nothing. That's why both consumer surplus and producer surplus are really forms of **economic rent**, about which much more later. Alfred Marshall correctly called consumer surplus and producer surplus "Consumer's Rent" and "Producer's Rent".

What about **profit**? In this simple model, profit and producer surplus are the same. However, once time comes in, the story changes. (Also, some economists use the term profit as a return to risk-taking.)

The lump sum/time problem. A demand curve for eggs makes perfectly good sense; we can visualize how it's made up by aggregating the demand curves of hundreds of thousands of individual consumers. Likewise, we can visualize a supply curve for eggs made up of hundreds of small producers.

But demand/supply approach breaks down where there are large, lump sum investments either by consumers or producers.

When we buy a house, a car, a fridge, a college education—we're buying a stream of services that we expect to last for years. To be sure, we can construct a demand curve for cars, broken down by size, make, year etc, based on sales and price data from dealerships. But that's a step removed from demand for auto transportation. And there are major confounding factors, starting with the availability of credit, which in turn depends not only on individual wealth, but also the state of the economy.

The problem is worse with producers. Almost any form of production requires a substantial up front lump sum investment. The egg farmer must buy the land and barn and flock of hens. Economists may try to get around this problem, again following Marshall, by using a concept of

* Of course Columbia isn't actually selling its land at present, but an appraiser could estimate the price.

"long term average cost" but that creates other problems, including mixing sunk costs with variable costs.

In short, conventional a-temporal microeconomics breaks down analyzing demand and supply over long periods with lump sum costs. We must turn to the economics of time, which conventional microeconomics largely omits.

Substitutes and complements. Of course people don't buy or produce products in a vacuum. They're influenced by the price and availability of other products.

Substitutes. Usually there are many substitutes for a given product, both close and distant. Medium eggs are a substitute for jumbo eggs. Land 'O Lakes is a substitute for Breakstone butter. Margarine is a substitute for butter. Olive oil is a substitute for spreads. Roasting is a substitute for frying in spreads or oil. If the price of jumbo eggs goes up, some people switch to smaller ones. If butter goes up, some people switch to margarine. If spreads and oils go up, some people switch to roasting instead of frying food.

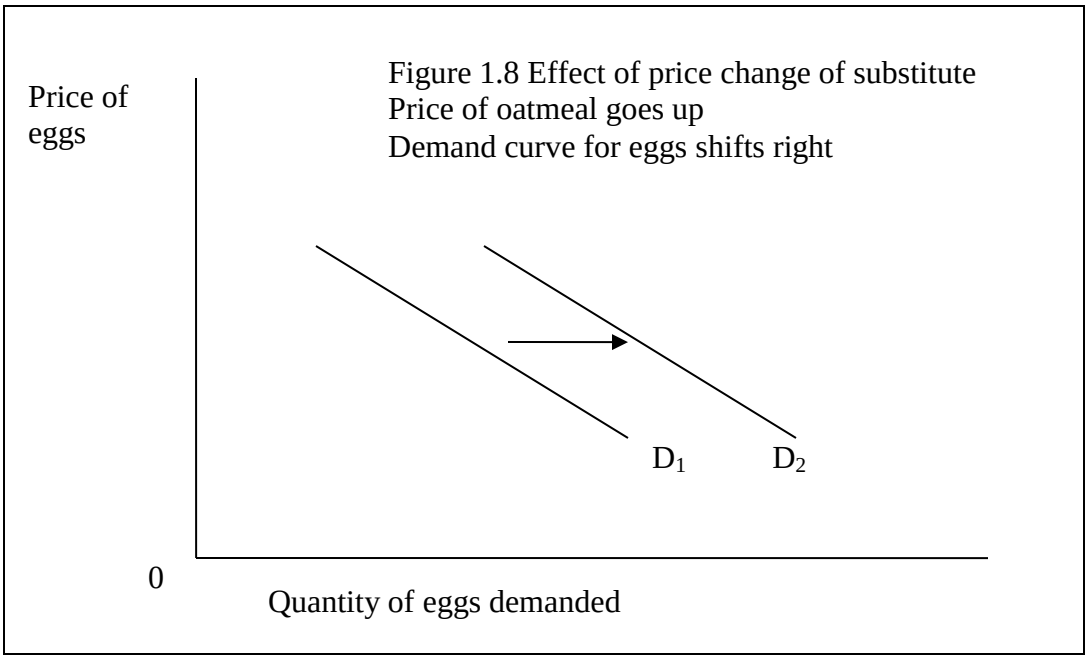
Substitutes and complements affect supply curves too. For example, suppose the price of broiler chickens goes up. Some egg farmers may switch to producing broiler chickens instead. As a result, the egg supply curve will shift to the left. That is, fewer eggs will be supplied at given price.

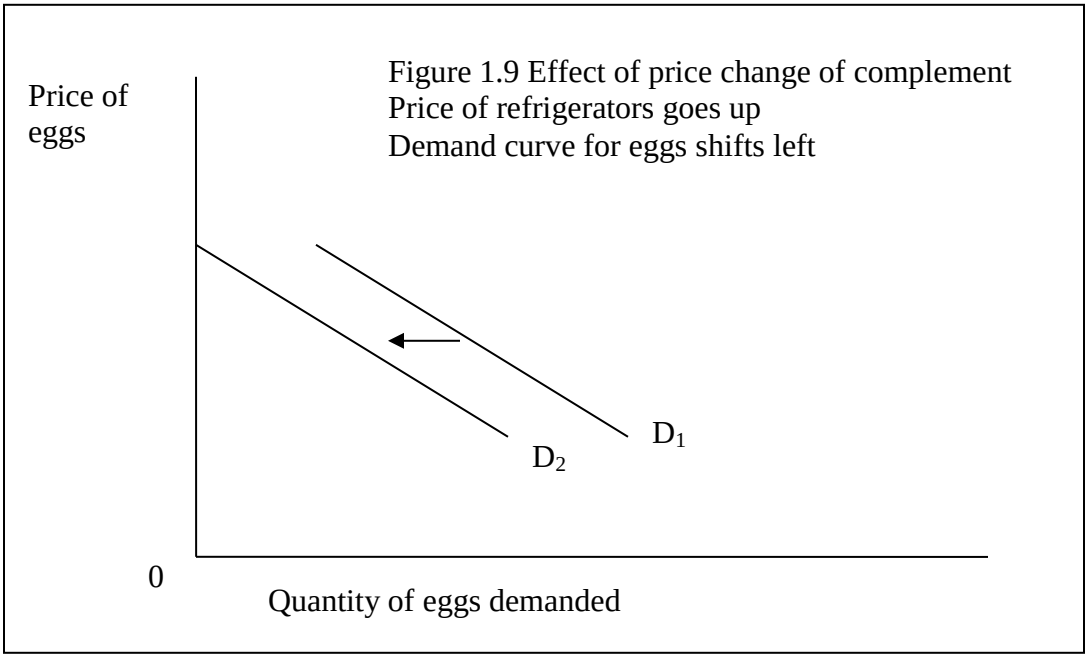
Needs. Economists tend to cringe when they hear someone say, "We **need** a new highway," as if the world would end if we didn't get one. There are always substitutes, like a new bus route, or simply living with the old road. We may not like the fact that going to a dentist substitutes for a toothache, but that's life. And speaking of life, what about "People need at least 1400 calories a day!" It may sound heartless, but there are substitutes for 1400 calories a day, like sleeping more. The word "need" cuts off observation and discussion. (I tried—not always successfully—to train my kids to say "I *want* a cookie," not "I *need* a cookie.")

Complements. Until 150 years ago, there were no right and left shoes. But today, you wouldn't buy one without the other, so right and left shoes are strong complements. Ditto 5/32 inch nuts and bolts. Butter, margarine, olive oil, hummus and cheese complement bread; if the price of bread rises, people may buy less rather than more of them. Gasoline complements cars; when the price of gas goes up, people buy fewer and smaller cars. As suggested in Figure 1.1, people don't buy infinite quantities of eggs even if the price is zero, because they lack a vital complement: fridge space to store them. As we will see, physical space is an essential complement to everything we do.

Graphing effects of substitutes and complements. Graphically, changes in the price of substitutes or complements shift the demand and supply curves left or right. (Remember, price on the y axis is the independent variable, while quantity on the x axis is the dependent variable.) If oatmeal is a substitute for eggs, and the price of oatmeal goes up, the demand curve for eggs will shift right, as in Figure 1.8. If fridge space is a complement for eggs, and the price of fridges goes up, the demand curve for eggs will shift left, as in Figure 1.9.

Substitutes and complements play an important role in the choice of production technology, which I will discuss in the section on production.


Price of eggs
Figure 1.8 Effect of price change of substitute
Price of oatmeal goes up
Demand curve for eggs shifts right
D1
D2
0
Quantity of eggs demanded


Price of eggs
Figure 1.9 Effect of price change of complement
Price of refrigerators goes up
Demand curve for eggs shifts left
D1
D2
0
Quantity of eggs demanded