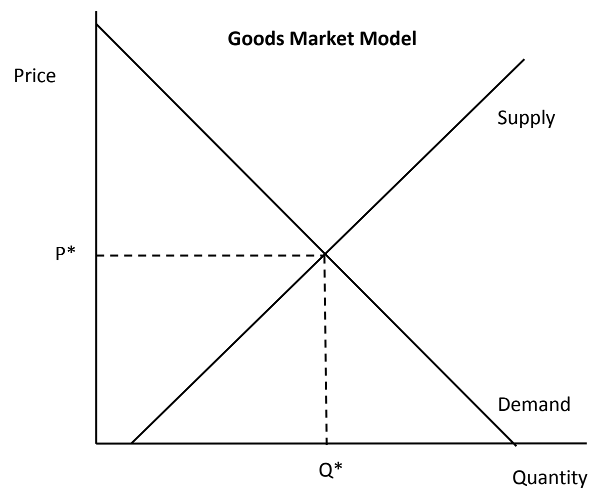
Evaluating Economic Models[1]
Instructional Primer[2]

In this primer we'll look at a very simply system of equations, tables and graphs and discuss how they interact one with another. It's important to note that in economics, graphic models are most often used in the abstract to represent the dynamics of movement within a system. As such, an economic graph isn't simply a chart with values, but a graph that presents multiple elements in relation to each other, represented by various values as constrained by the axes of the graph, and indicating the effects that changes in some values have on other values and levels.

In much of economics we use equations to form tables of values and graphs, or sometimes we'll use tables of values to form graphs and possibly equations. In many cases, if you have one of these three elements, you have enough information to have the other two. We'll start with a set of supply and demand equations and from these we'll work to find five distinct elements:

1. Equilibrium – the point at which two or more curves are equal to each other, in a competitive market model this is often referred to as the market clearing point.
2. Intercepts – the points along each of the model's axes where the described curve cross each axes
3. Graphic – a visual model most often based on some form of X,Y graphic, typically focused in positive (+,+) space
4. Table – a set of values resulting from changing one of the model's variables.
5. Elasticity – a value resulting from the change in one variable in respect to another.



The above graph might represent a goods market model in which the market clearing points of equilibrium are noted as $P*$ and $Q*$, or the levels of Price and Quantity that clear the market. So let's start with a basic set of supply and demand equations suggestive of some equilibrium, or a point at which the two are equal to each other – in this case we'll use a factor input model with labor as an input to production in which we consider two variables, wage (W) and labor (L), where wage is simply the price of labor and is measured in some currency and labor represents some quantity units of manpower.

[1] This primer is intended to present an abbreviated discussion of the included economic concepts and is not intended to be a full or complete representation of them or the underlying economic foundations from which they are built.

[2] This primer was developed by Rick Haskell (rick.haskell@utah.edu), Ph.D. Student, Department of Economics, College of Social and Behavioral Sciences, The University of Utah, Salt Lake City, Utah (2014).

In models, equations are simply formulas that define a line or curve; in this case we'll look at labor supply (L_S) and labor demand (L_D)

$$L_S = 10 + 2W \quad (1)$$

$$L_D = 42 - 2W \quad (2)$$

Note that these are linear equations and as such will produce straight lines, or curves, with demand being downward sloping and supply upward sloping as we might expect.

Equilibrium

We suppose that at some point the two curves, will cross to form a point of equilibrium; a point at which the two are the same. You know that you can solve a system of two equations with two unknowns and you might see these two equations as having three variables, but if you think of L_S and L_D as the same, which they are at the point of equilibrium, then we can treat the system as having two unknowns. So let's set L_S and L_D equal to each other as follows:

$$L_S = L_D \quad (3)$$

$$10 + 2W = 42 - 2W$$

$$4W = 32$$

$$W^* = 8 \quad (4)$$

To find L^* we simply need to put W^* into either one of the two equations with which we began. The reason we can use either one is that at the point of equilibrium, the two equations are actually the same; they represent the same point on the graph. For simplicity we'll substitute W^* into L_S

$$L_S = 10 + 2(8)$$

$$L^* = 26 \quad (5)$$

Intercepts

Having solved for L^* and W^*, our equilibrating values of L and W, we now know at least one point on our graph at which both L_S and L_D reside. Now let's find the intercepts on the X and Y axes so we can have one or two more points on the graph with which we might plot our curves. To do this we'll take each equation and by turn, set the values to 0 and find the resulting value of the remaining variable. The rationale behind is actually simple: in our labor market model with labor on the X axis and wage on the Y axis, when $L = 0$ it means that the point represented by the equation is on the wage axis.

For labor supply ($L_S = 10 + 2W$)

When $W = 0$, $L_S = 10 + 2(0)$ or $L_S = 10$

When $L_S = 0$, $0 = 10{+}2W$

$2W = -10$ or $W = -5$

So labor supply transects the labor (X) axis at 10 and the wage (Y) axis at – 5. If this seems odd given the (+,+) space represented by the graph, simply extend the graph into one of the other three Cartesian coordinates

For labor demand ($L_D = 42 - 2W$)

When $W = 0$, $L_D = 42 - 2(0)$ or $L_D = 42$

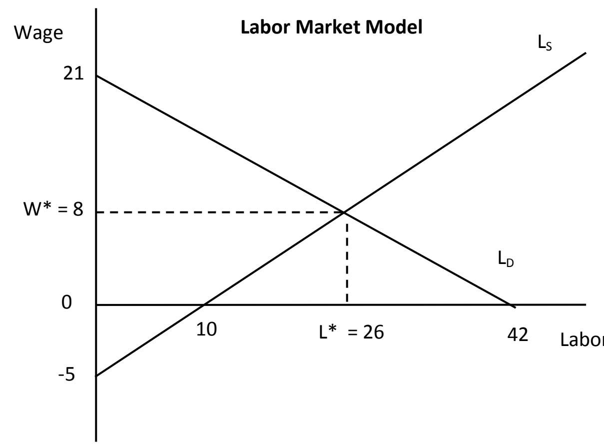
When $L_S = 0$, $0 = 42 - 2W$,

$2W = 42$ or $W = 21$

So labor demand transects the labor (X) axis at 42 and the wage (Y) axis at 21.

Graph

Think about this in terms of the graph, if we extend the wage (Y) axis into negative space we see how LS transects both the wage and labor axes. We also see how L_D transects these axes. We actually only needed one point for either L_S or L_D because when we identified the equilibrium values we actually had another point identified for each of the two curves. It's worth noting that this is only completely accurate in this very simplistic model with linear curves. The same method of identifying the points of equilibrium and intercepts hold for non-linear equations and curves, but you need more than two points to graph the curves accurately.



Table

With the equations we can set up a table to represent values for L_S and L_D given specified values of W. We do this by substituting the selected value for W into each of the two equations. For example:

For labor supply ($L_S = 10 + 2W$)

If $W = 5$, then $L_S = 10 + 2(5) = 20$
If $W = 6$, then $L_S = 10 + 2(6) = 22$
If $W = 7$, then $L_S = 10 + 2(7) = 24$

For labor demand ($L_D = 42 - 2W$)

if $W = 5$, then $L_D = 42 - 2(5) = 32$
if $W = 6$, then $L_D = 42 - 2(6) = 30$
if $W = 5$, then $L_D = 42 - 2(7) = 28$

Notice that as W rises L_S rises and L_D falls, this is consistent with the fact that supply curves are upward sloping and demand curves are downward sloping. The tabular form we might more appropriately use is as follows:

W	$L_S = 10 + 2W$	$L_D = 42 - 2W$
0	10	42
1	12	40
2	14	38
3	16	36
4	18	34
5	20	32
6	22	30
7	24	28
8	26	26
9	28	24
10	30	22
11	32	20
12	34	18
13	36	16

Notice that with the table we can visually identify W^* and L^*, these are the values of W and L at which L_S and L_D are equal to each other.

Elasticity

Elasticity of supply or demand is simply a measure of the change in one variable in response to a change in another variable. We won't review elasticity in this primer other than to suggest the evaluation of economic models as presented here may inform us as to elasticity's measure. For more detailed information on elasticity see the ***Elasticity of Supply and Demand Instructional Primer***.

For our purposes, we'll simply note that with equations, table or accurate graphs we can identify the elasticity (η) presented given a particular change in one of variable. The simple elasticity formula is given as:

$$\eta = \frac{\%\,\Delta\,L}{\%\,\Delta\,W} = \frac{\frac{L_2 - L_1}{L_1}}{\frac{W_2 - W_1}{W_1}} \qquad (6)$$

Let's assume we want to gauge the own wage elasticity of demand as the wage variable changes from its market clearing level to \$10. We'll need to identify the initial values of W and L (W_1 and L_1) as well as the values of these variables following the specified change (W_2 and L_2) to meet the needs of the elasticity formula. We already know the market clearing levels are $W^* = 8$ and $L^* = 26$, so these are W_1 and L_1 respectively. We're also given the change in wage to \$10, so this is W_2 – all we need to do is identify the change in L and for this we'll rely on the L_D equation (since we're calculating the elasticity of demand). We can substitute \$10 into L_D as follows

$$L_D = 42 - 2(10) = 12 = L_2 \qquad (7)$$

Now we simply substitute our values for W and L into the simple elasticity equation

$$\eta = \frac{\%\,\Delta\,L}{\%\,\Delta\,W} = \frac{\frac{12-26}{26}}{\frac{10-8}{8}} = \frac{-\frac{14}{26}}{\frac{2}{8}} = \left(-\frac{14}{26}\right)\left(\frac{8}{2}\right) = -\frac{112}{52} = -2.154 > |-1| \qquad (8)$$

…. so we know that this is ***elastic***; the change in labor is greater than the change in wage. Note that this has a negative (-) value; we expect this from an own wage elasticity of demand.

Caution

You should become comfortable relying on tables and graphs to help identify certain characteristics of models, but don't depend on them for everything. There's power in being able to manipulate the model via the equations that define it: for example, if you're given the equations and model we've been using and are told that a minimum wage (W^M) is exogenously set at \$10, then that doesn't change the equilibrating values of W^* and L^* but will give us some values of L_S^M and L_D^M by substituting \$10 for W in the equations:

$$L_S = 10 + 2(10) = 30 = L_S^M \qquad (9)$$

$$L_D = 42 - 2(10) = 22 = L_D^M \qquad (10)$$

In this case, if $W = \$10$, we see that the labor market is no longer in equilibrium. It's been forced out of equilibrium by some form of friction (the exogenously imposed W) and we see that $L_S < L_D$ which would represent a surplus of labor at \$10 and result in some form of unemployment.