Price Controls and Quotas[1]
Instructional Primer[2]

In this primer we'll look at the effect price controls and quotas have on either goods market or factor input market models. Specifically we'll look at the effect of the imposition of a price floor, price ceiling and quotas greater than and less than the equilibrium quantity and how these effect prices, consumer surplus (CS), producer surplus (PS) and dead weight loss (DWL).

- Price Floor — an exogenously set price above the equilibrium price
- Price Ceiling — an exogenously set price below the equilibrium value
- Production Quota — an exogenously set quantity to be produced (either above or below the equilibrium quantity)

Let's start with a factor input market, a labor market, in equilibrium. We'll use the same equations and values used in the ***Evaluating Economic Models*** primer where we have equations for labor supply and demand, but this time we'll suppose W to be a per hour value and L to be a simple quantity of labor.

$$L_S = 10 + 2W \quad (1)$$
$$L_D = 42 - 2W \quad (2)$$

To find the equilibrating values we simply set the two equations equal to each other

$$L_S = L_D \quad (3)$$
$$10 + 2W = 42 - 2W$$
$$4W = 32$$
$$W^* = 8 \quad (4)$$

And then L^* we substitute (4) into either (1) or (2) For simplicity we'll substitute W^* into L_S

$$L_S = 10 + 2(8)$$
$$L^* = 26 \quad (5)$$

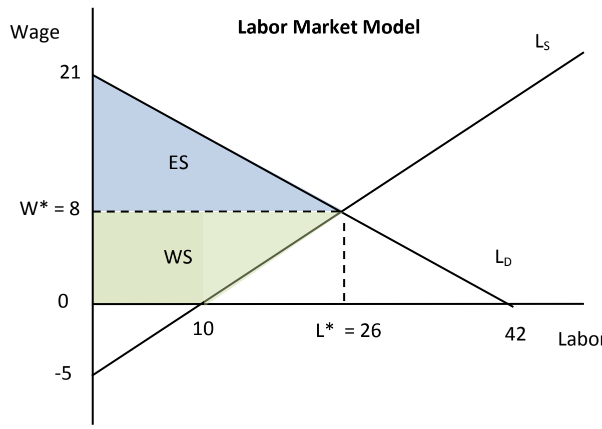
To find the X,Y axes intercepts for these curves that result from these equations we evaluate each equation separately:

For labor supply ($L_S = 10 + 2W$)	For labor demand ($L_D = 42 - 2W$)
When $W = 0$, $L_S = 10 + 2(0)$ or $L_S = 10$	When $W = 0$, $L_D = 42 - 2(0)$ or $L_D = 42$
When $L_S = 0$, $0 = 10 + 2W$	When $L_S = 0$, $0 = 42 - 2W$,
$2W = -10$ or $W = -5$	$2W = 42$ or $W = 21$

[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).

Which yields a graphic model that looks something like this:



By using the values we revealed through use of the L_S and L_D equations we can identify the values that will lead us to some CS, PS and DWL, but in this case we need to think about who the consumers and producers of labor are. The consumer of labor is the employer and the producer of labor is the worker, so rather than call these CS and PS we'll call them employer surplus (ES) and worker surplus (WS); DWL is still some overall reduction in social welfare. Since this model is in equilibrium there won't be any value for DWL, which is zero (0) in competitive market equilibrium. Recall that we can simply make these calculations by thinking of the areas for ES and WS as triangles ([base x height]/2) and rectangles (base x height) and then applying some basic geometry:

$$ES = \frac{(26)(21-8)}{2} = 169 \tag{6}$$

$$WS = (10)(8) + \frac{(26-10)(8)}{2} = 144 \tag{7}$$

Notice that WS is both a rectangle and a triangle, which isn't at all uncommon. Given this particular labor supply relation we note that at a wage of zero ($0), there are 10 workers prepared to work in this market – while this might sound unusual it might also be a reflection of some other benefit associated with working that isn't expressly reflected in the wage.

Also notice here WS doesn't extend to the area below the labor axis. This is due to the reality that a worker would never be expected to work for less than zero ($0) in our models.

Price Floor

Think of a price floor as a level we don't want prices to fall below. It will naturally be above the equilibrium value, otherwise there's no motivation for policy makers to set or enforce it, market conditions will appear to do that just fine. Now let's apply a price floor, such as a minimum wage, to that market by assuming that some legislative body decided that a minimum wage should be $10 per hour. By using our equations for L_S and L_D we can identify the values that will lead us to some CS, PS and DWL, but in this case we need to think about who the consumers and producers of labor are. The consumer of labor is the employer and the producer of labor is the worker, so rather than call these CS

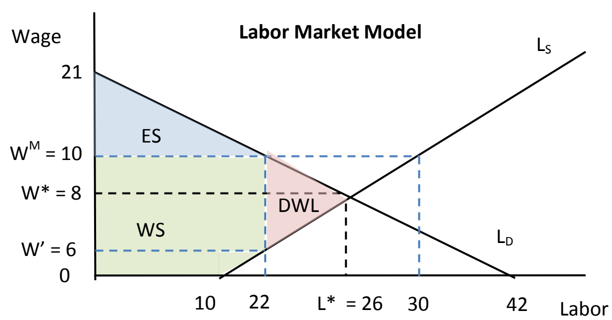
and PS we'll call them employer surplus (ES) and worker surplus (WS); DWL is still some overall reduction in social welfare.

We're given a minimum wage (W^M) at \$10, which doesn't change the equilibrating values of W^* and L^*, but by substituting it into L_S and L_D will give us some values of L_S^M and L_D^M. We'll also want to find the value on the wage axis representing some W' when L_S is equal to 22, this will become useful in identifying our ES, WS and DWL values as you can see from the following graphic model:

$$L_S = 10 + 2(10) = 30 = L_S^M \quad (8)$$

$$L_D = 42 - 2(10) = 22 = L_D^M \quad (9)$$

$$22 = 10 + 2(W'); \ W' = 6 \quad (10)$$



With these values in mind we can now calculate the areas of ES, WS and DWL

$$ES = \frac{(22)(21-10)}{2} = 121 \quad (11)$$

$$WS = (10)(10) + (22-10)(10-6) + \frac{(22-10)(6)}{2} = 184 \quad (12)$$

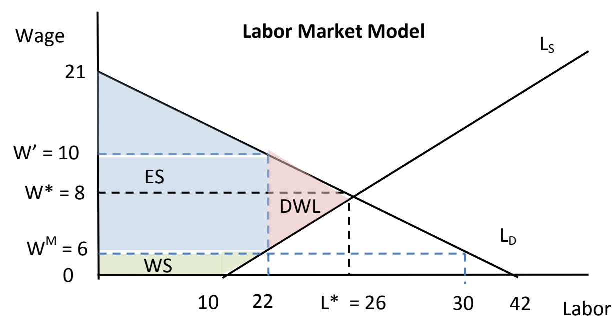
$$DWL = \frac{(26-22)(10-6)}{2} = 8 \quad (13)$$

It's worth pointing out that $ES+WS+DWL$ before the imposition of the minimum wage is the same as $ES+WS+DWL$ after the minimum wage. As we might expect, the immediate effect is a decrease is *ES*, increase in *WS,* and formation of *DWL*. We might also expect producers to raise output prices in the goods market as their input costs have risen, which we would expect to lead to a decrease in quantity demanded at equilibrium in that market. But these are issues for a separate discussion.

In this case, where $W^M = \$10$, 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. This unemployment is the foundation for the DWL observable in this market.

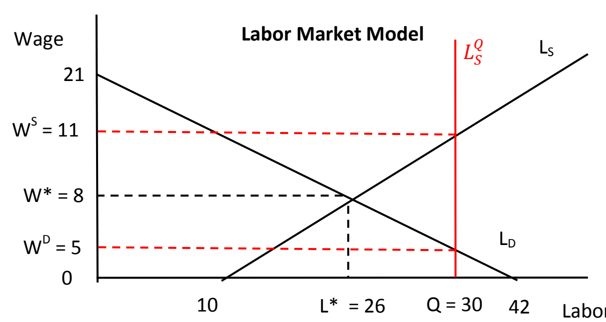
Price Ceiling

We can think of a price ceiling in very similar terms as can a price floor, with a price ceiling being an exogenously set level above which policy makers don't want prices to rise. Not unlike the price floor, it doesn't make a lot of sense to place a price ceiling above the equilibrium price since equilibrating market forces alone will keep the price below that particular ceiling. A price ceiling in the labor market may be the result of any number of policy issues, including policy makers' attempting to control inflation; if wages can't rise, it's harder for producer to raise goods market prices without seeing a decline in quantity. Rather than go through a complete example of a price ceiling in this primer, an example can be in the ***In-Class Problem Set to Price Controls and Quotas.*** Were we to consider a price ceiling of $6 for wages in the same labor market we've examined, the graphic model would look like the following:



Quotas

Let's suppose that in the labor market we've been analyzing there aren't any price controls, but there is a labor quota that's been imposed such that the subjects firms are required to hire 32 workers coupled with a required wage of $11; this might be in response to some form of union contract or social policy decision. If this is the case then we end up with a model with the same equilibrating values as before, but with a separate labor supply curve $\left(L_S^Q\right)$ representing the imposed quota.



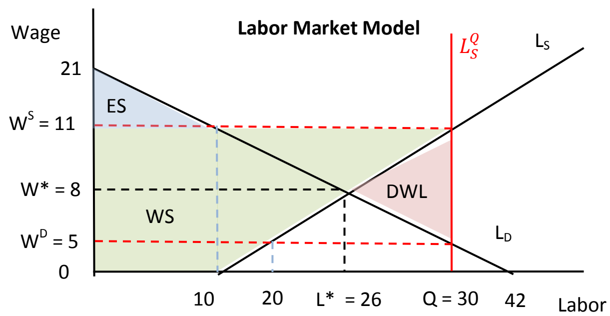
This yields additional value of W based on the labor supply and demand equations, which values result in some interesting challenges for the market to consider:

$$L_S = 32 = 10 + 2(W^S);\ W^S = 11 \qquad (14)$$

$$L_D = 32 = 42 - 2(W^D);\ W^D = 5 \qquad (15)$$

With this imposed quota, we have to concern ourselves with the wage that's going to be paid. When we substitute the quota into the L_S relation we see that in order for this market to supply the required number of workers the wage (W^S) will need to be paid $11 per hour (which in this particular case is the required wage). However, by substituting this same number of workers in the L_D relation we see that firms are only willing to pay $5 ($W^D$) for that number of workers.

So what does this tell offer in respect to ES, WS and DWL? This might be interpretable in a few different ways depending on whether or not the firm has to bear the burden of the extra workers and higher wage or if there is some form of government subsidy that assists with this. If the firm has to bear it, such as might be the case if this the result of a union contracts, then ES, WS and DWL may look like this:



We see that employer surplus is sharply reduced, which makes sense if the firm is required to bear the burden of the higher wage. We also see that worker surplus is not only sharply increased, but extends beyond the bounds of the sum of $ES + WS$ observed in a competitive market. We also see an area representing some dead weight loss, but this might be arguable: if the excess WS is greater than measurable DWL, is there a net loss to society? Without more information we may not be able to answer this, so we'll stick with measuring the areas as indicated above.

In order to calculate ES, WS and DWL we need to determine the values for L_S and L_D given the calculated levels of W^S and W^D. We do this by substituting W^S and W^D into L_S and L_D respectively:

$$L_S = 10 + 2(11) = 10 \tag{16}$$
$$L_D = 42 - 2(5) = 20 \tag{17}$$

And then we can plug these values into our methods for finding ES, WS and DWL

$$ES = \frac{(10)(21-11)}{2} = 50 \tag{18}$$
$$WS = (10)(11) + \frac{(30-10)(11)}{2} = 220 \tag{19}$$
$$DWL = \frac{(30-26)(11-5)}{2} = 12 \tag{20}$$

We'll look at an example of the quota being the result of government policy in the ***In-Class Problem Set to Price Controls and Quotas.***