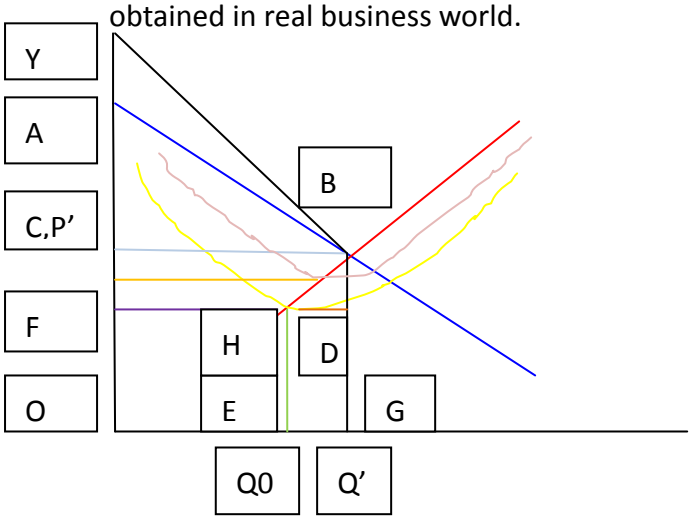
The further explanation of demand supply curve in microeconomics

Wanchung Hu
Graduate Institute of Economics
College of Social Sciences
National Taiwan University

Abstract
The demand supply curves represent the fundamental economics principles. However, there is lacking detailed relationship between company and the microeconomics when we apply this demand-and-supply curve. Thus, here, I propose a detailed explanation of microeconomic demand-and-supply curve to put material cost and labor cost in the graph. Thus, a more practical demand-supply graph can be obtained in real business world.



Text
Here, I will propose a new microeconomic demand-and-supply model shown in the following picture. Thus, the demand-supply curve can be more practical in real business world.

In the above graph, we can see the longterm demand curve is the blue line(MB curve: Marginal Propensity to Consume: MPC) and the longterm supply curve is the red line(MC curve, wage rate curve). B point is the equilibrium point. BY is 45 degree line, so the area YAB is equal to saving due to definition (1-MPC=MPS). The yellow line is the average variable cost and the pink line is the average total cost. Since this is the microeconomics curve, the supply line (marginal cost) line just begins from the bottom of D point (above average total cost). The consumer surplus is the area ABC(consumption). The producer surplus is the area BCFH which is the profit plus total fixed cost(assets). The total revenue is area BCOG. Here, we will see the

material cost is the area DGFO. It is because the material cost is in the linear relationship with each quantity of good produced. The labor cost is equal to the marginal cost line (red line). It is the wage rate and it is because the labor cost is in inverse relationship to the marginal productivity. The more workers are, the decreased productivity trend is. Thus, the labor cost is BDH triangle. The ladder area between dark yellow line and light blue line is the profit. The ladder area between dark yellow line and purple line is the fix cost. By using this principle, we can apply the demand-supply curve to real world business more practically.

I will further explain why I use -MPC for MB and Wage rate for MC here. MPC is the marginal propensity to consume for gaining the income. Minus sign is for downward demand curve. The formula is:

$$\mathrm{MPC} = \frac{\mathrm{dC}}{\mathrm{dY}}$$

Y means income, and we can use Q instead of Y from the Fisher equation MV=PQ=PY. Thus, C is the unit consumption. We can also derive utility from the above formula.

$$\frac{\mathrm{MU}}{\mathrm{P}} = \frac{\mathrm{MU_M}}{\mathrm{P_M}} = \lambda = \mathrm{constant}$$

$$\mathrm{P} = \mathrm{C} = -\mathrm{MPC} * \mathrm{Q} + \mathrm{k}$$

Thus,

$$\mathrm{MU} = -\mathrm{MPC} * \mathrm{Q} * \lambda + \mathrm{K}\lambda$$

$$\mathrm{TU} = \int \mathrm{MU}\,\mathrm{dQ} = -{}^{1}\!/_{2}\,\mathrm{MPC} * \mathrm{Q}^2 * \lambda + \mathrm{K}\lambda\mathrm{Q}$$

Thus, the total utility is a parabola curve with its downward opening. And, MU is a downward straight line. These fullfil the real world observation. Then, I will explain MC=wage rate'.

Let

$$\frac{\mathrm{dC}}{\mathrm{dQ}} = \frac{\mathrm{d(FC + NC + VC)}}{\mathrm{dQ}} = \frac{\mathrm{dVC}}{\mathrm{dQ}} = \mathrm{MC}$$

(C is the cost per unit good)

$$\mathrm{TVC} = \mathrm{VC} * \mathrm{Q} = \mathrm{w} * \mathrm{Q} * \mathrm{L}$$

(W is wage piece rate)

$$\frac{\mathrm{dVC}}{\mathrm{dQ}} = \mathrm{MC} = \mathrm{w} * \mathrm{d(L/Q)} = \mathrm{w/MP} = \mathrm{w'}$$

I call this w' real or practical wage rate which stands for marginal cost. MP rises first and goes down later, so marginal cost is a up-opening parabola curve.

In addition, the total variable cost curve can be deducted.

$$\mathrm{TVC} = \int \mathrm{VC} = \int \mathrm{MC} * \mathrm{Q} = {}^{1}\!/_{2}\,\mathrm{MC} * \mathrm{Q}^2$$

Here, I will try to deduct production function which is analog to Newton's mechanics. The net profit for company is total revenue minus total cost. So,

$$\pi = P'Q' - \left(F_c + N_c Q + {}^1\!/_2\, M_c (Q - Q_0)^2\right)$$

Here, F_c is the fixed cost(asset), N_c is the material natural substance cost, M_c is marginal cost which is the same as labor cost, and Q_0 is the minimal amount needed to produce(economic scale). Thus,

$$T_c(Q) = {}^1\!/_2\, M_c Q^2 + (N_c - M_c Q_0)Q + F_c + {}^1\!/_2\, M_c Q_0^2$$

This is the total cost function. And the below production function is $F^{-1}(x)$ of the total cost function:

$$Q = \frac{-(N_c - M_c Q_0) \pm \sqrt{(N_c - M_c Q_0)^2 - 2M_c\left(F_c - T_c + {}^1\!/_2\, M_c Q_0^2\right)}}{M_c}$$

If the MC line is passing the zero point, then:

$$N_c = M_c Q_0$$

Then,

$$Q = \frac{\sqrt{2M_c\left(TVC - {}^1\!/_2\, M_c Q_0^2\right)}}{M_c}$$

We can also calculate the consumption via the D-S equilibrium curve:

$$\text{Consumption} = \frac{1}{2}\text{MPC} * Q'^2$$

Consumer's income is:

$$\text{Income} = \frac{1}{2}Q'^2$$

Saving is:

$$\text{Saving} = \frac{1}{2}\text{MPS} * Q'^2 = \frac{1}{2}(1 - \text{MPC}) * Q'^2$$

Autonomous consumption, not shown here, is from pre-existing wealth.

Then, I will justify why the real MB and MC curve are two straight lines. MB(MPC) is a derivative from utility(parabola), so it is a straight line. MC itself is a parabola, but the practical MC line should be above AVC bottom which makes the MC curve to have local linearity. Thus, both MB and MC lines are straight lines. In addition, I will demonstrate the demand-supply PQ linear regression curve is efficient to show other situation changes such as quality, expectation, preference, substitutes, or

complementary goods. For example, if we put the expectation in the demand or supply curve. Then, the equation becomes multiple-linear regression (E means expectation):

$$P = \beta 1 + \beta 2Q + \beta 3E + \cdots + \mu$$

The expectation will not only affect price P but also affect quantity Q. Thus, there is high multicollinearity between E and Q.

Then, both $\beta 2$ and $\beta 3$ are not stastically significant. This makes the above equation ineffective. Due to the collinearity, we can let:

$$E = \varphi Q + k$$

Introduce it into the above equation to remove collinearity, we get:

$$P = (\beta 2 + \varphi \beta 3)Q + k\beta 3 + \beta 1 + \mu$$

Thus,

$$P = \gamma 1 + \gamma 2Q + \mu'$$

This simple P-Q linear regression curve is justified to rule out any multicollinearity. We can use the above principle to examine quality, preference, substitutes, or complimentary goods etc. These above situations will both move P & Q. The demand supply PQ linear regression is efficient to demonstrate economics phenomenon.

Then, we can examine each factor in demand and supply. In demand, factors including income, preference, associated good price, expectation, and buyers' numbers will affect the demand curve.

By inspecting the graph, the increase of income will shift the demand curve to the right by enhancing the area YBC. The slope, MPC, is usually not changed. It is a parallel right shift. Then, the coefficient Ψ is equal to zero. This means you will buy the same ratios of goods via increasing income. The gain in unit income will increase the gain in unit certain good. Preference is different. The increased preference for certain good will increase its MPC to let its slope steeper. If the income is the same, you will use the original area YBA(saving) to buy the good. Or, you may decrease the general propensity for other goods in order to buy this certain good. This means, in the area ABC(total consumption), the consumption area for this item will increase with the reducing consumption area for other goods via the increasing MPC slope for this item.

Expectation will also let MPC slope change. The income is not changed, so the demand curve won't right side shift. Thus, if you expect the item's price will be higher next year, you will use saving or reduce other items' budget to buy this certain item. Associated goods are another factors. It will change MPC slope as well. If the

good is substitute and it raised price. The saving YBA is usually not changed, and you will rearrange the area ABC to buy the certain good instead of its substitutes(Slope MPC for this certain good increases). If the good's complement raises its price, you will also rearrange the area ABC to buy other goods instead of this certain good(slope MPC for this certain good decreases). The assumption is total consumption is not changed. (Budget line: P_xX(orP_zZ)+P_yY=Consumption, X&Z are substitutes, Y is complements). During the cases of MPC slope change, the coefficient Ψ is not equal to zero. Finally, the buyers' numbers will also cause the demand curve parallel right side shift. The coefficient Ψ is also zero. The aggregated income is total buyers' income.

Then, we can also examine the supply curve. The investment price will change the supply curve. However, here I divided investment cost into fixed cost, material cost, and labor cost. The increase in fixed cost will not shift the MC curve. However, the ATC curve will move upward. Thus, the net profit will reduce if the equilibrium price and other technique advance are not changed. If the material cost increases, the supply curve will move parallel upward. This means the supply will decreases. If the labor cost increases, the slope of supply curve will increase which will also decrease the supply. In both cases, the net profit will reduce. Technique change will also affect the supply curve via decreasing labor or material cost. Besides, the expectation will also change the supply curve. If you think the item's selling price will increase next year, you will buy more material or to hire more labor this year to upward move and decrease the supply this year. Product is in inverse proportion to cost in general. Finally, the total sellers' numbers will right-side parallel shift the supply curve. The reason is similar to buyers' numbers for demand curve.