Tutorial 2. *Government Intervention in Competitive Markets. Solutions*

Problem 1. *Impact of Quantity and Price Controls.*
Consider a market in which demand is given by $P^D = 70 - 2Q^D$ and supply is given by $P^S = 10 + 2Q^S$.

a) What are the equilibrium price and quantity in an unregulated market? Calculate the value of consumer and producer surplus.
$P^* = 40$, $Q^* = 15$, $CS = \frac{1}{2}(70 - 40) \cdot 15 = 225$, $PS = \frac{1}{2}(40 - 10) \cdot 15 = 225$

b) Suppose government imposes a quota at $\overline{Q} = 10$. Find the resulting market price. Calculate consumer and producer surplus after the quota is imposed. Calculate the deadweight loss associated with the quota. Calculate the rent created by the quota.

Market price is determined by the price the consumers are willing to pay at the level of quota. In simple words, plug $\overline{Q} = 10$ *into demand to find the price when quota is imposed:* $\overline{P} = 70 - 2 \cdot \overline{Q} = 70 - 2 \cdot 10 = 50$.
$CS = \frac{1}{2}(70 - \overline{P}) \cdot \overline{Q} = \frac{1}{2}(70 - 50) \cdot 10 = 100$ *(obviously lower than in part (a) because consumers have to pay higher price and consume less).*
PS is represented by trapezoid: area under P=50, above S curve and up to Q=10. Before we calculate PS let's calculate MC of production when Q=10; substitute 10 into supply to obtain $\overline{MC} = 10 + 2 \cdot 10 = 30$. $PS = \frac{20+40}{2} \cdot 10 = 300$. *It is higher than in part (a) because producers get higher price. This is not always the case: PS depends both on price and quantity, if quota limit is very low PS might be actually lower than in competitive equilibrium.*
$DWL = \frac{1}{2}(\overline{P} - \overline{MC}) \cdot (Q^* - \overline{Q}) = \frac{1}{2}(50 - 30)(15 - 10) = 50$. *Recall that DWL represents gains from trade destroyed by the quota and that is the reduction in both consumer and producer surplus due to production levels below the efficient output* Q^*.
RENT. In the context of price/quantity control rent can be thought of as 'benefits created by the policy that would not exist otherwise. When quota is imposed producers get price above the marginal cost while in the competitive equilibrium P=MC. In Canada quotas are used to support farmers' incomes. In each year all farmers in the market collect rent equal to 'by how much price $\overline{P}$ *exceeds the' MC for the* $\overline{Q}$. *One period's rent generated by quota is* $(\overline{P} - \overline{MC})\overline{Q}$ *in a fixed period of time. Since this rent can be collected over many periods, the rent generated by quota will be equal to the present value of the stream of future rents. The present value of rent represents the benefits created by quota to the farmer and determines the price at which a farmer will be wiling to sell the quota. Alternatively, present value of rent determines the amount of money that producers will be willing to spend on lobbying government to introduce the quota or to oppose elimination of the quota once it is installed.*

CHECK: notice that DWL+CS+PS after quota = CS+PS before quota. If you look at the diagram it is obvious why it is so: both sides refer to the same area between D and S up to the equilibrium quantity and represent gains from trade. Recall the welfare impact of the quota: some of CS is transferred to PS and some part of both surpluses is destroyed.

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c) If instead of quota there is a price floor at $\overline{P} = 50$, will the outcome be similar to that of part (b)?

Essentially yes. At P=50 consumers demand only 10 units, so price and quantity in the market are the same in parts (b) and (c). Consumer surplus is the same. From producers' perspective price floor may be differen than quota. Notice that at P=50 producers are willing to produce more than 10 units, and we can expect that there will be excess supply which can be another source of inefficiency. There are several policy approaches regarding how this surplus is dealt with. In agriculture when government uses price floor as a means to support farmers' income usually government purchases all unsold produce (respective expenditure is floor price multiplied by the surplus quantity). Obviously this surplus cannot be sold in domestic market since the price is too high. In this case consumers pay twice to support the farmers: they face higher market price and the spending on the excess produce is financed by taxes. Alternatively government can pay farmers ***not*** *to produce in excess of quantity that can be absorbed by the local market at the floor price.*

Problem 2. *Minimum Wage vs. Employment Subsidy.* Consider a market for unskilled labor in which labor supply (measured in millions of people who are willing to work) is given by $w^S = .2L^S$, where w is hourly wage in dollars. The demand for labor is given by $w^D = 9 - .1L^D$. NOTE: this is the familiar demand-supply story. The only difference is in notation: now price is called wage and denoted w and quantity is denoted L.

a) Find the equilibrium wage and number of people employed in unregulated competitive market, show on a diagram.
(Same as before, in order to find equilibrium equate supply and demand $w^S = w^D$, solve for L^*.) Equating labor demand to labor supply solve for $L^* = 30$ and $w^* = 6$.

b) Suppose that government introduces minimum wage of $w_{min} = 7$. Calculate how many jobs will be destroyed by such policy. Discuss what would be a rationale for such intervention and what are the drawbacks of the policy both in short-run and long- run (over short and long run perspective). Who gains from this policy? Who loses?
At w=7 firms demand is $7 = 9 - .1L^D$, solve for $L = 20$ mln. 10 mln jobs is destroyed. Also at w=7 households are willing to supply $L^S = 5w = 35$, the resulting unemployment is 15 mln. Winners are the workers who are able to keep their jobs - they earn higher wage (the gains are represented by rectangle: $w_{min} - w*$ - the increase in wage for the 20 mln employed). Losers are clearly the firms who hire less labor and pay higher wage and also the workers who lost their jobs (or those who will have hard time finding a job). Notice that there is a dead weight loss associated with the policy. The welfare losses that are not reflected on the diagram: more time is wasted on job search since more people are willing to look for a job (the amount of resources that workers are willing to 'waste' is represented by the area similar to the rent created by the quota). Unemployment also creates possibility for discrimination by the employers. Recall from the lecture that one of the main criticism of the minimum wage policy is that it hurts the very people it is meant to protect: the most affected are the workers with low marginal product, which is first of all young and teenagers who enter the workforce and lack experience. If in short-run firms' response to an increase in min. wage is to lay off/reduce hiring, in the long-run firms will tend to replace labor with capital or introduce labor saving technologies which will have further negative impact on the employment.

c) Suppose that instead of the minimum wage government decides to introduce a subsidy. The subsidy works as follows: for each worker that a firm hires, government pays $1 dollar per hour. Calculate the impact of this policy on the market: number of people hired, market wage after the subsidy, PS, CS, DWL and government expenditure associated with the policy. Compare this subsidy to the minimum wage policy, discuss its advantages and potential drawbacks.
The logic is similar to that of taxing a good. Whatever is the equilibrium wage received by the workers, government pays 1 dollar back to the firms, therefore firms actually pay 1 dollar less than what workers receive, that is why in equilibrium after the subsidy $w^D = w^S - 1$, *where 1 is the amount of the subsidy. Substitute the labor demand and supply curves for* w^D *and* w^S *respectively:*
$9 - .1L = .2L - 1$*; rearrange and get* $10 = .3L$, *which gives you after subsidy employment of* $L = 33.\overline{3}$*; check: subsidy should increase the market quantity, so after the subsidy is introduced employment is above competitive equilibrium.*
Substitute $L = 33.\overline{3}$*into the labor supply to obtain the wage that workers bring home* $w^S \approx 6.67$. *- this is effective wage after the subsidy .*
Substitute $L = 33.\overline{3}$ *into the labor demand to calculate wage effectively paid by the firms: 5.67 (exactly one dollar less than wage received by the workers).*
Total subsidy payment is subsidy/worker times employment = 33.3 mln.
Firms' surplus is represented by the same area where CS would normally be: under the demand and above the price paid (5.67); firm's surplus is $\frac{1}{2} \cdot (9 - 5.67) \cdot 33.3 = 55.4445$.
Workers' surplus will be in the area corresponding to the producer surplus, which is area under price received (6.67) and above the labor supply, workers' surplus is $\frac{1}{2} \cdot (6.67 - 0) \cdot 33.3 = 111.0555$
$DWL = \frac{1}{2}(33.3 - 30) \cdot 1 = 1.65$ *CHECK: welfare impact of the subsidy Notice the following. In competitive equilibrium the total welfare is* $PS + CS = \frac{1}{2} \cdot 9 \cdot 30 = 135$. *After subsidy PS+CS=166.5, which is equal to the original surpluses PLUS money injected by the government into the market, MINUS the DWL -the welfare destroyed due to inefficient allocation of resources. Similar to taxes subsidies generate dead weight loss. When government subsidizes production above competitive equilibrium the marginal value of the output produced above competitive equilibrium level is below the marginal cost of production, so literally the value of the extra output is below the cost. When you represent the after subsidy surpluses on the diagram you notice that CS and PS overlap. This happens because government injects extra money into the market. Up to L=30 67 cents of each subsidy dollar goes to workers and 33 cents goes to the firm. Notice that after L=30 MSC is higher than MSB, and out of each dollar of subsidy some part is lost die to inefficiency. Finally, the last cent of the subsidy did not contribute neither to PS nor to CS because for the last labor hour the MSC=6.67 was exactly one dollar higher than MSB=5.67.*

Key points in comparing the two policies: both policies will result in higher wage received by workers; both policies are associated with a welfare loss: minimum wage results is under-employment while subsidy creates over-employment. Both firms and workers are better off under the subsidy, however subsidy must be finances from tax revenue that will be collected in other markets - somebody will have to pay for it. Subsidy is one of the support policies used in Canada: it is a targeted program to encourage firms to employ people who are at disadvantage compared to other job applicants and would not be hired otherwise. Usually government pays the firm some part of the wage for a period of time

(payment and the duration of subsidy depend on a situation).