Bilkent University
Econ 101 - Fall 2022
Chapter 9: Why Competitive Equilibrium is (Sometimes) Good

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Contents

1 What We Are About To Do

In this chapter, we will revisit some territories we usually hesitate to visit: we will get *normative*. That is, we will go a little beyond the question on *what happens* in an economy, and we will start asking *what should happen*. To this end, we will occasionally make some *value judgments*. In this sense, some of the ideas we explore will remind you of Chapter 3 (in particular, the First Welfare Theorem). However, we will go a few steps beyond discussing why competitive equilibrium allocation is "desirable". We will also discuss how various government interventions distort the outcome, and take us away from the desirable outcomes.

The overarching conclusion of this chapter is that: sometimes, competitive markets are a decent way to organize economic activities. I want to warn you in advance: this is the chapter that a lot of people mentally get stuck in. Once you learn the concepts we are about to cover, some of you will have an urge to say: "Markets are amazing! Why intervene in them at all?" I would kindly ask you to resist that urge as much as possible. In order to do that, please remember how we ended up here: we basically made a bunch of assumptions (we assumed consumers are rational, they know the prices, their preferences satisfy diminishing marginal rate of substitution, the goods in question are ordinary goods, producers are not cash constrained, their productions function satisfy the law of diminishing returns, everyone is a price taker...) What you should remember here is: *under these assumptions*, competitive markets are a decent way to organize economic activity. This is why the title for this chapter has the word "(Sometimes)" in it.

Beginning with next chapter, we will start checking out what happens when we change some of these assumptions. For instance, we will study what happens when not everyone is a price taker, or when one economic agent's economic activity affects others. But for now, let's stick with these assumptions. The material here corresponds to Chapter 4 of your textbook.

2 Gains from Trade

As it happens, in order to make value judgments, we need to have some measure of *value*. Let's move there with a quick mental exercise.

Suppose that you are a **social planner** who controls a market for a certain good or service. That is, there is a certain good or service, and there is a particular set of producers and a set of consumers you control. Moreover, suppose that you are extremely powerful: you have the power to go any producer, make them produce the good by any amount, take these goods and give them to any consumer by any amount. (At this point, you are not even bound by the price mechanism: you can extort the producers into producing the goods and you can force consumers into consuming them.) The question you face is: **what is the quantity you will require to be produced and consumed? Who will produce and who will consume?**

To answer this question, we need to specify what you, the social planner, care about. And this is precisely the part we get normative. In particular, you may want to create the best outcome for the consumers, the best outcome for the producers, or a particular group of consumers etc... This is the question of what you *value* the most, and it is an ethical question: it does not have any right answer. Still, we will extend our boundaries a little and assume the following: **the social planner wants to maximize the gains from trade**.

"But what is the gains from trade?", you might say. Basically, whenever the social planner makes the producer produce a good and a consumer consumes it, she is creating some *gains* in the economy. A measure of these gains is the difference between how happy it makes the consumers *and* how costly it is for the producers. The good news is: we already have a name for these objects! In particular, when Q'-th unit of the good is produced by the marginal producer and is consumed by the marginal consumer:

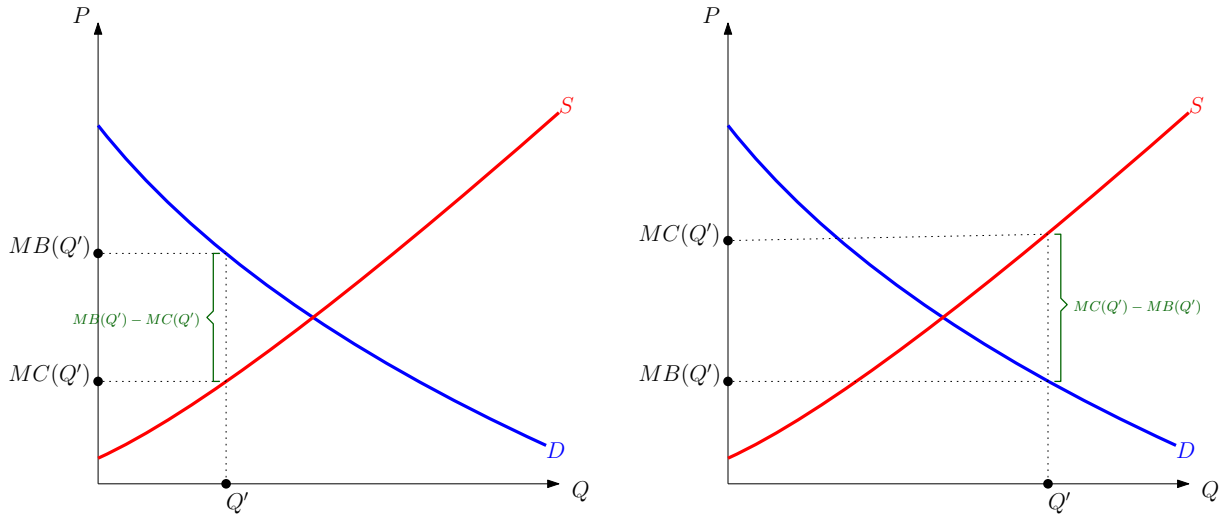
- $\text{MB}(Q')$, the marginal benefit of the marginal consumer, is how much the marginal consumer values the consumption of the Q'-th unit (in monetary terms).
- $\text{MC}(Q')$, the marginal cost of the marginal producer, is how costly it is for the marginal producer to produce the Q'-th unit (in monetary terms).

All in all, the gains from producing and consuming the Q'-th unit is:

$$\text{MB}(Q') - \text{MC}(Q')$$

Note: this can even be negative. That would mean that producing and consuming the Q'-th unit is not socially desirable (according to what the social planner cares about, i.e., when the objective is maximizing gains from trade).

Note: by now this should give an idea on why we defined the "dual interpretations" of the market demand and market supply curves. For a quantity Q', the market demand curve illustrates $\text{MB}(Q')$ and the market supply curve illustrates $\text{MC}(Q')$. Therefore, the gains from producing and consuming the Q'-th unit is the vertical difference between the demand and supply curves. See Figures 1a and 1b below.



(a) The case where $MB(Q') - MC(Q') > 0$.

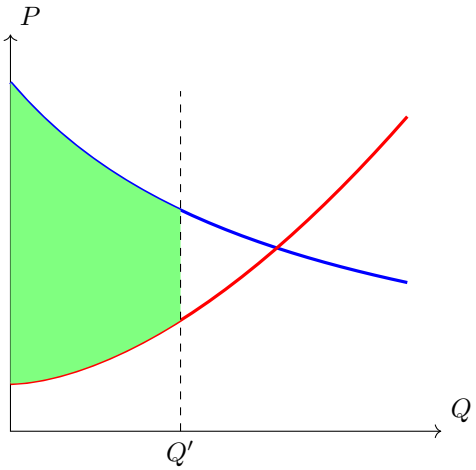
(b) The case where $MB(Q') - MC(Q') < 0$.

Figure 1: Gains from trading Q'-th unit.

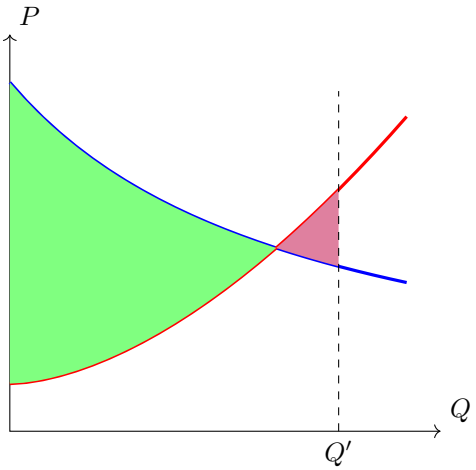
The total gains from trading Q' units is called the **economic surplus** from producing and consuming Q' units. This is simply the sum of all the gains from trading all Q-th units, where Q varies between 0 and Q'.

From now on, we will assume that the social planner always finds the producer who produces the marginal unit at the lowest marginal cost, and the consumer who values the marginal unit most (i.e., who has the highest marginal benefit).[1] Then, the **economic surplus** from trading Q' units is the area below the market demand and above the market supply from $Q = 0$ to $Q = Q'$ (area of regions in which supply is above demand, i.e., marginal cost is higher than marginal benefit, is taken as negative).

[1] It is kind of obvious that the social planner always targets these people, but we will not get into the details here.



Economic surplus from producing Q' units and consuming it is given by the green area.



Economic surplus from producing Q' units and consuming it is given by the green area minus the purple area.

2.1 The Efficient Quantity

Okay, the social planner just wants to maximize the economic surplus by choosing the quantity Q. So, what will be the quantity chosen by the social planner? Put simply, the social planner will require the producers to produce and require the consumer to consume the quantities as long as $\text{MB}(Q) \geq \text{MC}(Q)$. When $\text{MB}(Q)$ is decreasing (i.e., when the law of demand is satisfied) and $\text{MC}(Q)$ is increasing (i.e., when the law of supply is satisfied), this process stops at the point where there are no more gains from trade to exhaust. This quantity is called the **efficient quantity**, and is denoted Q^*. This is the value of Q^* that satisfies:

$$\text{MB}(Q^*) = \text{MC}(Q^*)$$

See Figure 2 below.

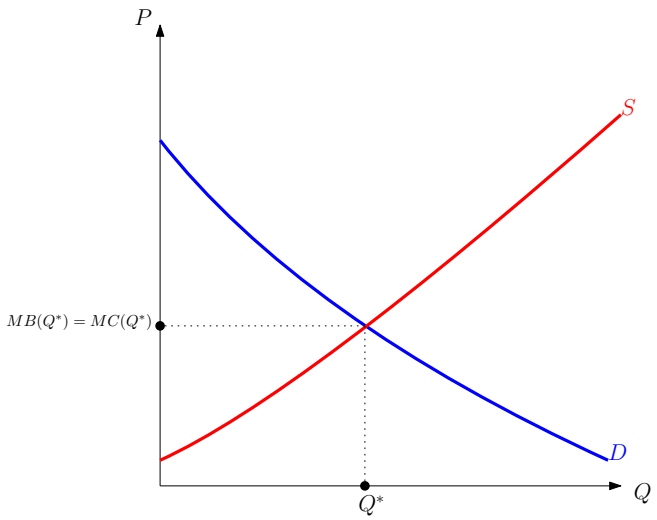


Figure 2: The total gains from trade is maximized at the quantity Q^*.

The gains from trade under quantity Q^* is the maximum value of **economic surplus**. See Figure 3 below.

All in all, the social planner maximizes the economic surplus by:

1. Calculating Q^*,

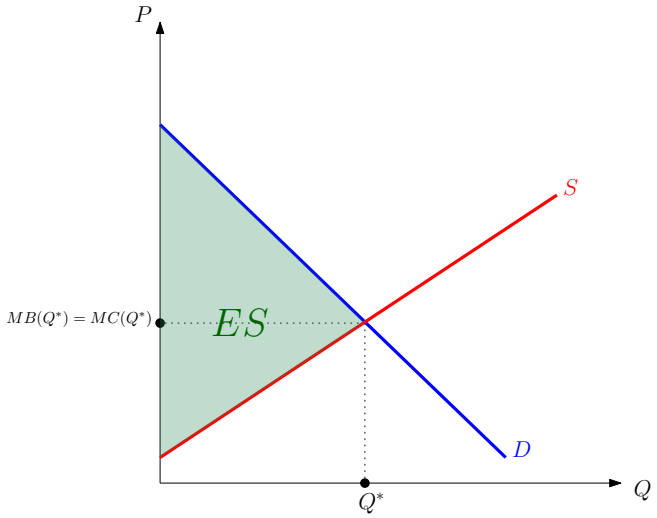


Figure 3: The total gains from trade at quantity Q^* is the economic surplus (ES), illustrated with the green area.

2. Finding the producers with the lowest marginal cost, making them produce Q^* units of good,
3. Finding the consumers with the highest marginal benefit, making them consume Q^* units.

2.2 What Can Go Wrong?

This looks simple enough in theory, but in practice, can a social planner do that easily? I would argue not. I can think of three potential, very serious, problems.

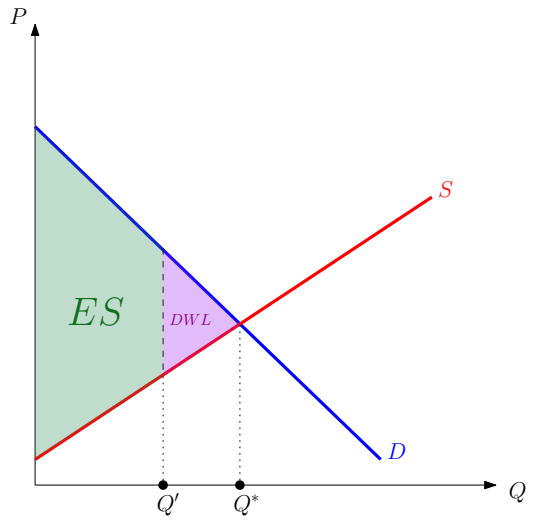
1. The social planner may not be able to find the producers with the lowest marginal cost.
2. The social planner may not be able to find the consumers with the highest marginal benefit.
3. Perhaps most importantly, the social planner may not be able to calculate Q^* correctly. After all, market demand curves and market supply curves are some analytical devices we designed to better understand economic interactions. There is no such thing as a market demand curve or a market supply curve out there in the wild. If I asked someone to draw the market demand curve for milk in Turkey for 2022, would they be able to draw it? I suspect not.

So, what will happen is the social planner is unable to set Q^* correctly, i.e. what if she sets $Q' \neq Q^*$? We will have a lower economic surplus than what is achievable.

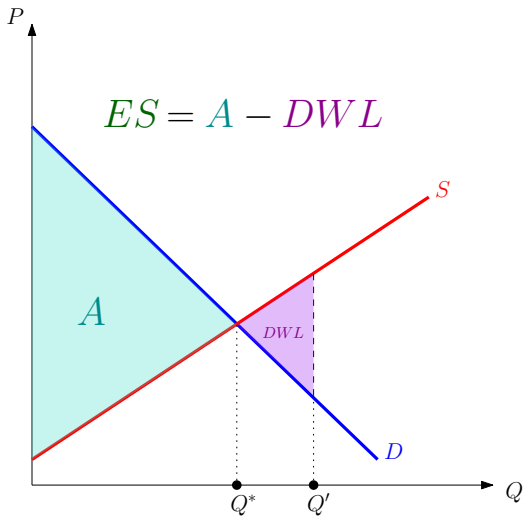
- If the social planner sets $Q' < Q^*$, then the society has *too little trade*. This results in some gains from trade not being realized, and the society losing a small triangle. The economic surplus in this case will the the maximum economic surplus possible minus a triangle.
- If the social planner sets $Q' > Q^*$, then the society has *too much trade*. This results in some units being produced even though the cost of producing them is higher than the gains. We end up with a small triangle of negative surplus. The economic surplus in this case will be the maximum economic surplus possible minus a triangle (because the triangle enters to the equation as negative).

In any case, we have a triangle that the society is "losing". The area of the triangle is the **difference between the maximum economic surplus and the economic surplus from trading Q' units**. We call this difference **deadweight loss**, or DWL for short. See Figures 4a and 4b.

So, to recap: we have a definition of economic surplus (or gains from trade) we want to maximize. We know the solution that maximizes the economic surplus, but guaranteeing that we find this solution is indeed very



(a) Consequences of setting $Q' < Q^*$.



(b) Consequences of setting $Q' > Q^*$.

difficult. What can we do? If only there was a mechanism that guarantees maximum economic surplus... Wait, we do!

3 Competitive Equilibrium Maximizes Economic Surplus

This may have occurred to you by now, but let's spill the beans. **Competitive equilibrium of a market maximizes the economic surplus.** It does so by making sure that the market demand and market supply curves intersect. Then,

$$P^{eq} = \text{MB}(Q^{eq}) = \text{MC}(Q^{eq})$$

Moreover, any consumer who consumes the Q'-th unit at the competitive equailibrium price has $\text{MB}(Q') \geq P^{eq}$ and any producer who produces that unit has $\text{MC}(Q') \leq P^{eq}$. That is, the competitive equilibrium automatically finds the consumers with highest value and producers with lowest cost through the price mechanism.

Isn't this fantastic? Basically, you can just lean on your back and let the market "work its magic" by finding the efficient quantity, the highest-value consumers and the lowest-cost producers. The *invisible hand* of the market acts as a social planner who maximizes the economic surplus! **Competitive equilibrium is "good".**

This is a cute finding, but as I told you before: please do not fall in love with markets just because of this. There are many, many assumptions that go behind this result. If some of these assumptions are violated, we may not have the competitive market achieving the maximum economic surplus. This is why **competitive equilibrium is "sometimes" good.**

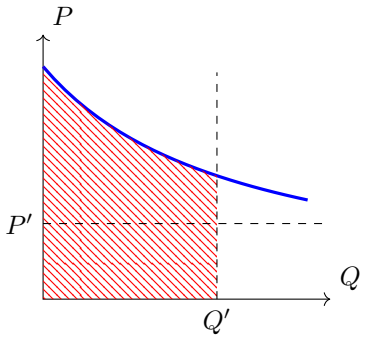
3.1 Consumer Surplus and Producer Surplus

So, competitive equilibrium results in maximum economic surplus. There are some total gains from trading in a competitive equilibrium. But what part of those gains goes to consumers, and what part goes to the producers? This is important to know because soon, we will analyze some government policies and investigate who are the winners and who are the losers from those policies (i.e., whose surplus becomes larger and whose becomes smaller). To calculate the fraction of total surplus that goes to either side, we decompose it into the **consumer surplus** and **producer surplus**.

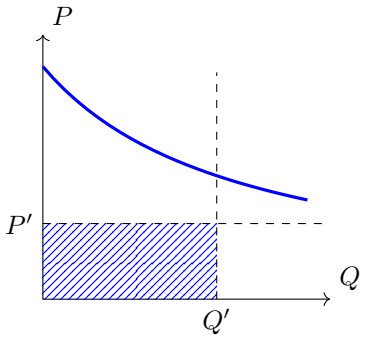
3.1.1 Consumer Surplus

Consumer surplus, denoted CS, is a measure of a consumers' total gains from trade in a market. It is the amount by which the total amount the consumer is willing to pay exceeds what she actually pays.

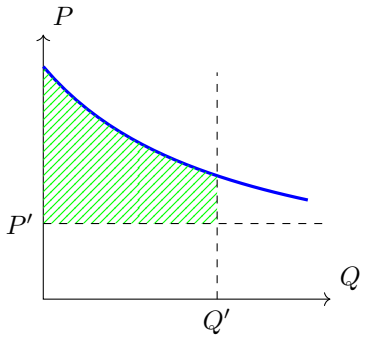
The **consumer surplus** from consuming Q' units of a good at the price of P' is the difference between the highest payment that the consumers are willing to pay to consume Q' units (the benefit of the consumers from consuming Q' units) and the amount they have to pay ($P' \cdot Q'$).



The shaded area gives the maximum amount the consumers are willing to pay in order to consume Q' units of the good.



The shaded area gives the amount that the consumers have to pay in order to consume Q' units of the good, when the price of the good is P'.



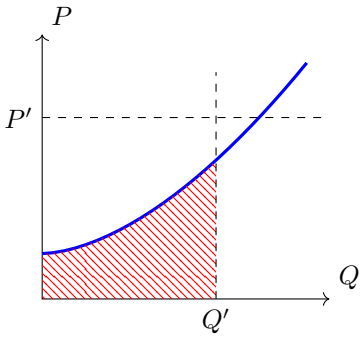
The shaded area gives the difference between the maximum amount that the consumers are willing to pay and what they have to pay in order to consume Q' units of the good at the price of P'. This is the consumer surplus from consuming Q' units which the consumer purchased at the price P'.

Given a market demand, **consumer surplus** from consuming Q' units at the price of P' is a measure of the gain of the consumers from consuming Q' units at the price P'. The area between the market demand (the marginal benefit) and the price line $P = P'$ from $Q = 0$ to $Q = Q'$ gives the consumer surplus.

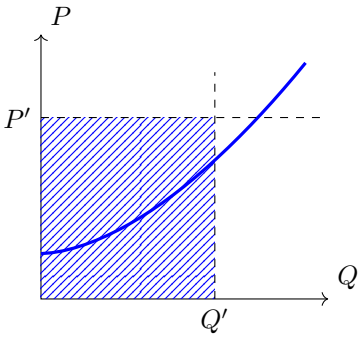
3.1.2 Producer Surplus

Producer surplus, denoted PS, is a measure of a producers' total gains from trade. It is the amount by which the total payment the producers receive exceeds the minimum amount that the producers would require to produce the good.

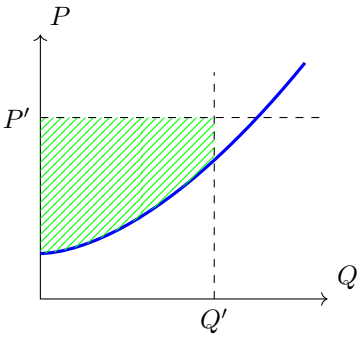
The **producer surplus** from producing (and selling) Q' units of a good at the price of P' is the difference between the payment the producers receive from selling Q' units of the good at the price of P' ($P' \cdot Q'$) and the minimum payment the producers would require to produce Q' units of the good.



The shaded area gives the minimum payment the producer would require in order to produce Q' units of the good.



The shaded area gives the amount that the producer receives when it sell Q' units of the good at the price of P'.



The shaded area gives the difference between the minimum payment that the producer requires and what it is payed when it sells Q' units of the good at the price of P'. This is the economic surplus from producing Q' units and selling it at the price of P'.

Given a market supply, **producer surplus** from producing Q' units and selling at the price P' is a measure of the gain of the producers from this action. The area between supply (market marginal cost) and the price line $P = P'$ from $Q = 0$ to $Q = Q'$ gives producer surplus.

3.1.3 Total Surplus

In a market, the sum of CS and PS gives the economic surplus ES. This is also sometimes referred to as the **total surplus**, denoted TS. In a competitive equilibrium without any external interventions (e.g., in a **free market**), the total surplus is equal to the maximum economic surplus. That is, there are no deadweight losses in a free-market competitive equilibrium. In a moment, we will see that government interventions create deviations from the free-market competitive equilibrium and generate deadweight losses.

3.2 The "Meaning" of Prices

While we are on it, let me take a slight detour and get a little philosophical. What is the "meaning" of a price in competitive equilibrium? As in, if we know the price of a good being traded in a market, what does the price say about that good?

Our answer to this question, based on our analysis so far, is: "Prices reflect very little information about the good, if any." All in all, in a competitive market, the price is used for making sure that there is no shortage or surplus. **In a competitive market, the price is nothing but a coordination mechanism.**[2] The consumers see the prices and decide on quantity demanded. The producer see the prices and decide on quantity supplied. The price adjusts such that the quantity demanded is equal to quantity supplied.

An implication of this idea is that: when I, as a consumer, buy a good or service at a price P, it says very little about my valuation of that good. The only information it conveys is that: my marginal benefit of consuming that particular good has to be above P. No other information is conveyed. For instance, when I buy a shirt at 100 TL, it does not mean that I value this particular shirt at 100 TL, and it also does not mean that the cost of producing this particular shirt is 100 TL. It only says that somewhere, some consumer has a marginal benefit of 100 TL and some other producer has a marginal cost of 100 TL.

This may seem like an obvious idea to you, but it wasn't that obvious to 18th-19th century thinkers! If you went to David Ricardo or Karl Marx and asked what the price of this shirt meant, they would steer towards saying that it says something inherent about this particular shirt (it reflects my valuation for this shirt, or

[2] Friedrich Hayek, one of the most inluential thinkers of 20th century, won a Nobel Prize in 1974 for formulating this idea – in a much, much more sophisticated manner, of course.

the cost of producing this shirt). What we call the **marginal revolution** of 19th century, i.e., the discipline of thinking at the margins, allowed us to take a break from this reasoning. On a broad level, this is the main reason why you are learning **neoclassical economics** in this class: we are breaking down the connection between prices/valuations/costs, and only relating them through marginal benefit and marginal cost.

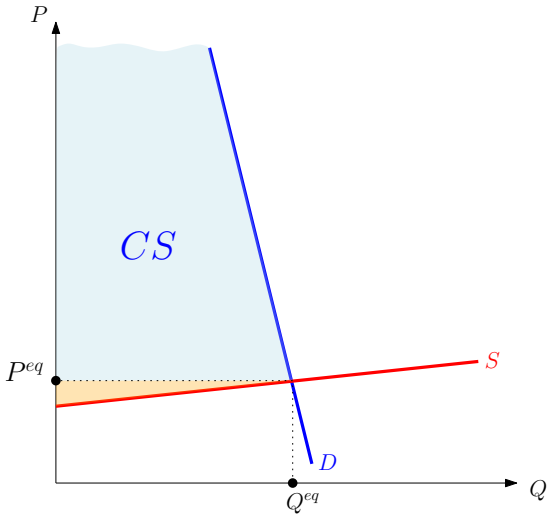
Just one more thing. What I said does not mean that other theories of economics (sometimes called *heterodox economics*) are wrong. We happen to teach neoclassical economics, and it is a disciplined way of drawing some conclusions from some assumptions. It is up to you to evaluate the reasonable-ness of these assumptions and conclusions.

3.2.1 The Diamond-Water Paradox

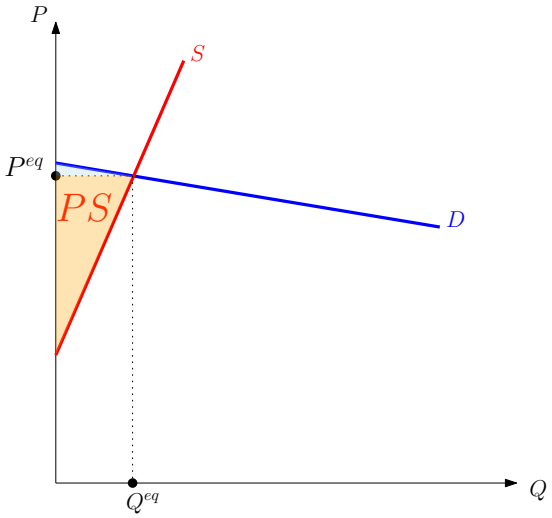
Here is an example of a "paradox" that bothered a lot of 18th century thinkers because they did not witness the marginal revolution yet: "Water, by all means, is a much more essential commodity than diamond. We could not survive without water, but we can keep living in the same manner without diamonds. Therefore, water is much more valuable. Then why it is so cheaper compared to diamonds?"

Adam Smith is believed to be the one who posited this question, but variants of it go back to Ancient Greece. Based on our discussion so far, we can say that this is hardly a paradox any more.

- First of all, we said over and over that the price of a good is not a measure of its value. It is merely a measure of its marginal benefit, evaluated at the equilibrium quantity. The equilibrium quantity is the key here: it does not only depend on the demand curve, but also the supply curve. Indeed, if we only looked at the demand curve, we would see that the marginal benefit of water is higher than the marginal benefit of diamond **at a given quantity**. (This is especially true for small quantities: if you are in the middle of the desert, you would be willing to pay much more for a gram of water than a gram of diamond.) Yet, it turns out that the supply of diamond is very limited, and thus the equilibrium quantity is limited, which results in a higher marginal benefit of diamonds at the equilibrium quantity.
- If you insist of having a measure of a good's total value, it is the **consumer surplus** in equilibrium. And as you can see, we may very easily have a low price for water but a very high consumer surplus. This actually follows easily from our discussion of elasticities. It is not hard to imagine that the demand for water is very inelastic (after all, it the *the* necessity). Presumably, the supply of water is very elastic (i.e., the supply curve is very flat – probably the marginal cost of extracting water does not increase very fast). Altogether, then, we conclude that the consumer surplus is very high in the water market, and the producer surplus is very low. For the diamond market, the reverse is true. See Figures 5a and 5b.



(a) Equilibrium of the water market.



(b) Equilibrium of the diamond market.

4 Government Interventions

Having defined the crucial concepts, we are now in a good position do discuss some "popular" government interventions. The overarching conclusion of these examples will be: government interventions in a competitive equilibrium create deadweight losses. We will, indeed, go beyond this observation and see who the winners and losers of such interventions will be. We can do this because we already defined the total gains of consumers from trade (CS) and the total gains of producers from trade (PS). Thus, for instance, if PS decreases, we will say: "Overall, producers are the losers from this government intervention.

4.1 Price Ceilings

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a price ceiling in this market. From now on, the price of the good cannot be above P^c liras."

Examples: price ceilings are frequently used in agricultural markets (onion/potato price are sometimes set by the government), in sectors where public health concerns are prevalent (masks etc.) Perhaps the most notable example is **rent controls**.

What will happen with a price ceiling?

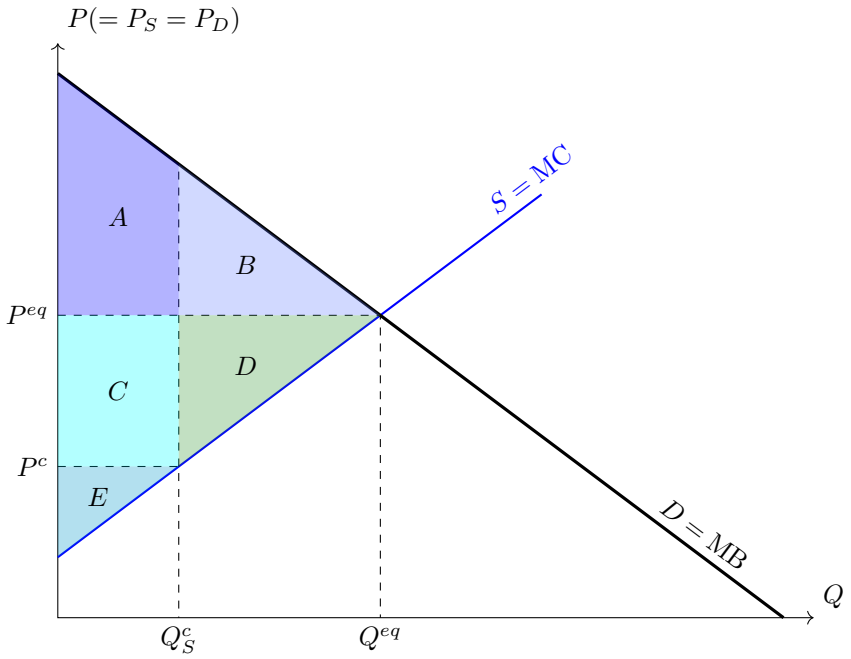
- If $P^c \geq P^{eq}$, we have an **ineffective price ceiling**: the free market competitive equilibrium price is already below the price ceiling. The equilibrium price will remain at P^{eq} and the equilibrium quantity will remain at Q^{eq}. There will be no changes in CS, PS, ES, and there will be no DWL.
- If $P^c < P^{eq}$, we have an **effective price ceiling**. In this case, the quantity demanded under price P^c, Q^c_D, is larger than the quantity supplied under price P^c, Q^c_S. Indeed, by the law of demand and the law of supply and $P^c < P^{eq}$, we have:

  $$Q^c_S < Q^{eq} < Q^c_D$$

  Therefore, there is **shortage** in the market with price P^c. Without any government interventions, the price would rise back to P^{eq} to prevent the shortage. Yet, with an effective price ceiling, the government does not allow the prices to rise. As a result, the equilibrium quantity traded will be dictated by the smaller of two quantities: Q^c_S.

We conclude: with an effective price ceiling, the price will be P^c and the quantity traded will be $Q^c = Q^c_S$. What happens to the consumer and producer surplus? Let's investigate the figure:

Economic Surplus and Deadweight Loss with an Effective Price Ceiling P^c



	Free Market	With Price Ceiling
CS	$A + B$	$A + C$
PS	$C + D + E$	E
Economic Surplus $= \text{CS} + \text{PS}$	$A + B + C + D + E$	$A + C + E$
Maximum Economic Surplus	$A + B + C + D + E$	$A + B + C + D + E$
DWL	0	$B + D$

A couple of notes:

- An effective price ceiling unambiguously reduces the producer surplus (it reduces from $C + D + E$ to E). This is because:
  - Some producers reduce their supply of the good at the lower price – recall that this is the reason why quantity traded decreases from Q^{eq} to Q_S^c. This leads to the loss of D in producer surplus.
  - Moreover, for every unit sold, the producers are receiving a lower payment. This leads to a loss of C in producer surplus.

  Both of these effects reflect negatively on PS.
- An effective price ceiling may increase or decrease the consumer surplus ($A + B$ may be larger or smaller from $A + C$, depending on the shape of the demand curve.)
  - Some consumers cannot buy the good they could consume before the price ceiling. This is because without a price ceiling quantity traded is Q^{eq}, whereas with a price ceiling it reduces to to Q_S^c. This leads to the loss of B in consumer surplus.
  - However, for every unit bought, the consumers are paying a lower price. This leads to a gain of C in consumer surplus.

  The net effect on CS may be positive or negative. But it is useful to keep in mind that **there are winners and losers from an effective price ceiling among the consumers.** Some of them enjoy the price ceiling (they are paying lower prices!) and some of them hate it (they cannot find the goods to buy, even though they are willing to pay a higher price than P^c!)
- In net, however, the sum of consumer and producer surplus unambiguously decrease. This is because some profitable trades are lost with an effective price ceiling. The result is a DWL of $B + D$.

So... with an effective price ceiling, producers lose, some consumers gain, and some consumers lose. There may still be justifications to use price ceilings (maybe the government really cares about the winners?) but it is important to keep the consequences in mind.

Consider rent controls: with an effective upper limit on rent, it seems like the government is protecting the tenants in the city. This is partly true, but is missing some parts of the picture. **First,** the landlords are the unambiguous losers of this policy. **Second,** because the rents are lower, some landlords decide not to rent their houses at all (they may use the houses themselves, or use it as a warehouse etc.) As a result, the total supply of houses available for rental decreases. Due to this decrease, some tenants (who were able to find houses before the rent controls) cannot find houses any more. **Third,** on net, fewer gains from trade are created because some houses are not rented. This reflects a typical *cautionary tale* of policy-making: you always have to think about the winners and losers, and be aware of the consequences.

4.2 Price Floors

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a price floor in this market. From now on, the price of the good cannot be below P^f liras."

Examples: Most famously, minimum wage. (Think of labor as a commodity that is sold in the market. The workers are the "producers" and the employers are the "consumers" of labor.)

What will happen with a price floor?

- If $P^f \leq P^{eq}$, we have an **ineffective price floor**: the free market competitive equilibrium price is already above the price ceiling. The equilibrium price will remain at P^{eq} and the equilibrium quantity will remain at Q^{eq}. There will be no changes in CS, PS, ES, and there will be no DWL.
- If $P^f > P^{eq}$, we have an **effective price floor**. In this case, the quantity supplied under price P^f, Q_S^f, is larger than the quantity demanded under price P^f, Q_D^f. Indeed, by the law of demand and the

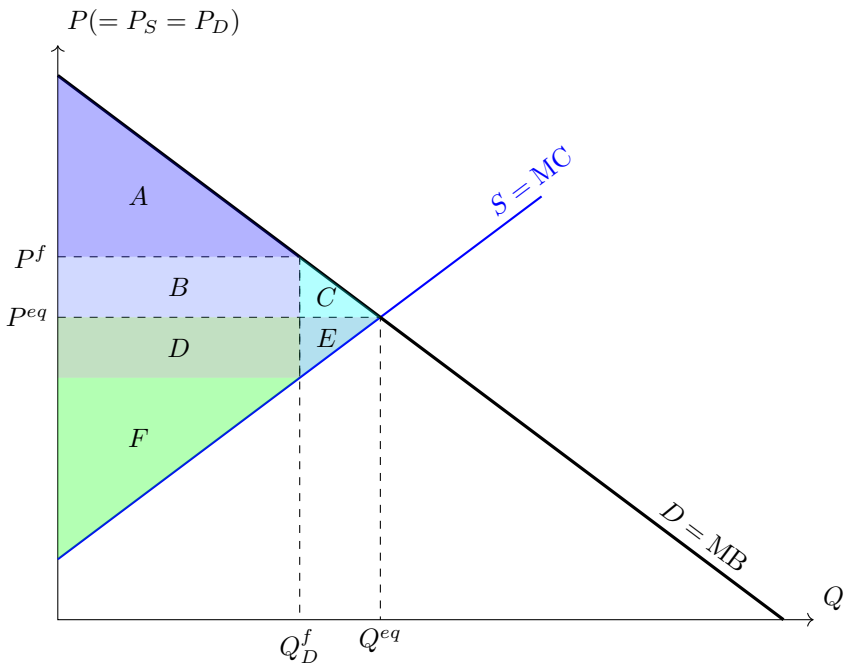
law of supply and $P^f > P^{eq}$, we have:

$$Q_D^f < Q^{eq} < Q_S^f$$

Therefore, there is **surplus** in the market with price P^f. Without any government interventions, the price would fall back to P^{eq} to prevent the surplus. Yet, with an effective price floow, the government does not allow the prices to fall. As a result, the equilibrium quantity traded will be dictated by the smaller of two quantities: Q_D^f.

We conclude: with an effective price ceiling, the price will be P^f and the quantity traded will be $Q^f = Q_D^c$. What happens to the consumer and producer surplus? Let's investigate the figure:

Surplus and Deadweight Loss with an Effective Price Floor P^f



	Free Market	With Price Floor
CS	$A + B + C$	A
PS	$D + E + F$	$B + D + F$
Economic Surplus = CS + PS	$A + B + C + D + E + F$	$A + B + D + f$
Maximum Economic Surplus	$A + B + C + D + E + F$	$A + B + C + D + E + F$
DWL	0	$C + E$

Once again, couple of notes:

- An effective price floor unambiguously reduces the consumer surplus (it reduces from $A + B + C$ to A). This is because:
  - Some consumers reduce their demand of the good at the higher price – recall that this is the reason why quantity traded decreases from Q^{eq} to Q_D^f. This leads to the loss of C in consumer surplus.
  - Moreover, for every unit sold, the consumer are paying a higher price. This leads to a loss of B in consumer surplus.

  Both of these effects reflect negatively on CS.
- An effective price floor may increase or decrease the producer surplus ($B + F + D$ may be larger or smaller from $E + F + D$, depending on the shape of the supply curve.)
  - Some producers cannot find the consumer they could find to sell before the price ceiling. This is because without a price floor quantity traded is Q^{eq}, whereas with a price floor it reduces to to Q_D^f. This leads to the loss of E in producer surplus.
  - However, for every unit sold, the producers are receiving a higher price. This leads to a gain of B in producer surplus.

  The net effect on PS may be positive or negative. But it is useful to keep in mind that **there are winners and losers from an effective price floor among the producers.** Some of them enjoy the price floor (they are getting higher prices!) and some of them hate it (they cannot find the consumers to sell, even though they are willing to sell at a lower price than P^f!)
- In net, however, the sum of consumer and producer surplus unambiguously decrease. This is because some profitable trades are lost with an effective price ceiling. The result is a DWL of $C + E$.

So... with an effective price floor, consumers lose, some producers gain, and some producers lose. There may still be justifications to use price floors (maybe the government really cares about the winners?) but it is important to keep the consequences in mind.

Consider minimum wages: the government is trying to protect the workers with an effective lower limit on wage. This is true, but **if we have a competitive market for labor,** there are some consequences to be kept in mind. **First,** the employers are the unambiguous losers of this policy. **Second,** because the wages are higher, some employers decide to employ fewer labor. As a result, the total demand for labor decreases. Due to this decrease, some workers (who were able to find jobs before the minimum wage) cannot find jobs any more. **Third,** on net, fewer gains from employment are created because some workers are not hired.

Note: these consequences really depend on the competitive market assumption (most importantly, the assumption that everyone is a price taker, and no firm is powerful enough to change wages unilaterally.) It is up to you to determine whether this is a reasonable assumption for many labor markets. **Also note:** the government may still choose to impose a minimum wage, on the grounds that she cares about the gains to workers who keep their jobs. Or even, the government may say that it does not approve a lower wage on ethical grounds: it is just inhumane to employ people at wages below poverty levels. All of these are valid justifications. Still, it is important to be aware of the consequences.

4.3 Taxes on Producers

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a per unit sales tax on the producers in this market. From now on, for every unit that is sold, the producer who sells the good has to pay me T liras."

Examples: abundant. Basically, any sales tax.[3]

What will happen with a tax on producers?

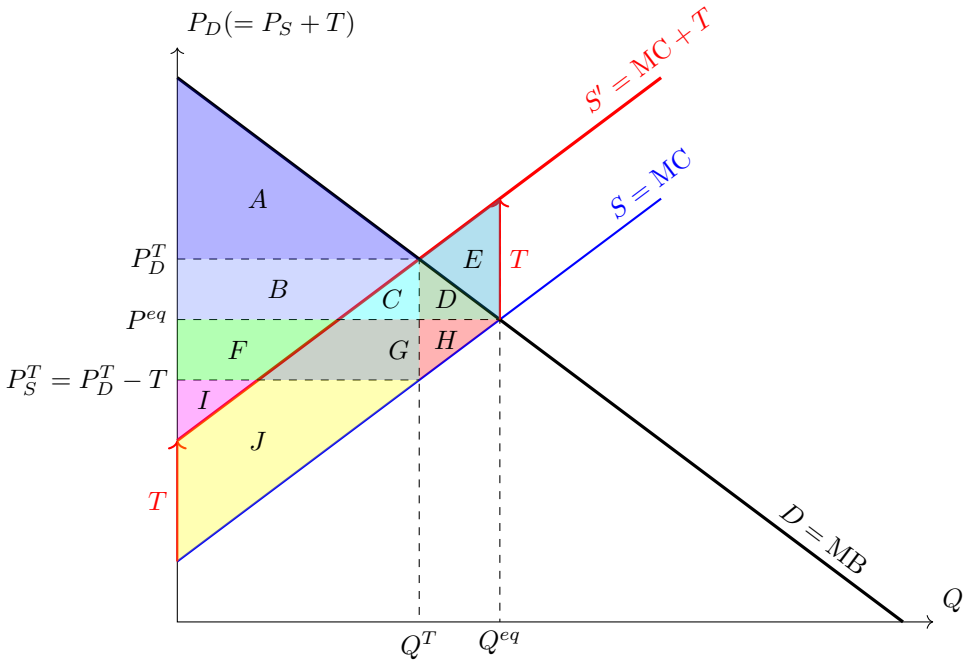
[3] A sales tax is typically is a percentage of the sales price, but the overall conclusions would not differ much.

- Recall what we said in Chapter 5, when we were discussing the variables that shift the supply curve. A tax on producers will cause a northwestern shift on the supply curve. This is because for each quantity Q, the marginal cost of producing and selling the Q-th unit is now $\text{MC}(Q) + T$ instead of $\text{MC}(Q)$. Therefore, the supply curve will shift upwards by T liras.
- As a result, the equilibrium will shift in the northwestern direction: the quantity traded under taxation will be $Q^T < Q^{eq}$ and the price that the consumers pay will be $P_D^T > P^{eq}$.
- Note, however, that the price producers receive will be lower than the price consumers pay. This is because the producers have to pay T liras to the government per each unit sold. Therefore, the price producers receive in equilibrium is $P_S^T = P_D^T - T$. The (Q^T, P_S^T) point lies on the original supply curve. We calculate the producer surplus based on the area between the original supply curve and P_S^T.[4]
- The tax revenue of the government (TR) is the quantity traded (Q^T) times the per unit tax (T). Therefoe, $\text{TR} = Q^T \cdot T$.

Perhaps it is best to investigate the figure.

[4]Equivalently, we can calculate it as the area between the shifted supply curve and P_D^T. It would give the same answer.

Surplus and Deadweight Loss with Unit Tax T on Producers



	Free Market	With Taxation
CS	$A + B + C + D$	A
PS	$F + G + H + I + J$	$I + J$
Tax Collected (TR)	0	$B + C + F + G$
Economic Surplus $= \text{CS} + \text{PS} + \text{TR}$	$A + B + C + D + F + G + H + I + J$	$A + B + C + F + G + I + J$
Maximum Economic Surplus	$A + B + C + D + F + G + H + I + J$	$A + B + C + D + F + G + H + I + J$
DWL	0	$D + H$

A couple of notes:

- Both CS and PS unambiguously decrease as a result of taxation. The price that consumers pay is larger than the free market price, and the price producers receive is smaller than the free market price.
- We are including the tax revenue in the economic surplus. The implicit assumption is that: the tax collected by the government does not "disappear", and the government feeds it back to the economy in a way that creates welfare. In a sense, this is the "best case" scenario.
- Still, even when the tax revenue is fully included in the economic surplus, there is some deadweight loss. Intuitively, this is because of the following: the government says "Every time a consumer and a producer make a trade, I demand T." When the gains from producing and consuming a unit is less than T (i.e., when $\text{MB}(Q) - \text{MC}(Q) < T$), the parties of the transaction stop trading, because it does not generate enough gains to cover for what they pay to the government. The result is a DWL of $D + H$.
- The tax revenue is $B + C + F + G$. Even though the producers are legally required to pay the tax, in equilibrium, the producers and consumers share the tax burden. Note that: $B + C$ is taken away from the **consumer surplus**: effectively, this is the tax burden that the consumers pay. $F + G$ is taken away from the **producer surplus**: this is the tax burden that the producers pay. Therefore, **even though one side of the market is required to pay the tax, both sides of the market share the tax burden**. We will come back to this observation.

4.4 Taxes on Consumers

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a per unit sales tax on the consumers in this market. From now on, for every unit that is bought, the consumer who buys the good has to pay me T liras."

Examples: abundant. Basically, any type of consumption tax.[5]

What will happen with a tax on producers?

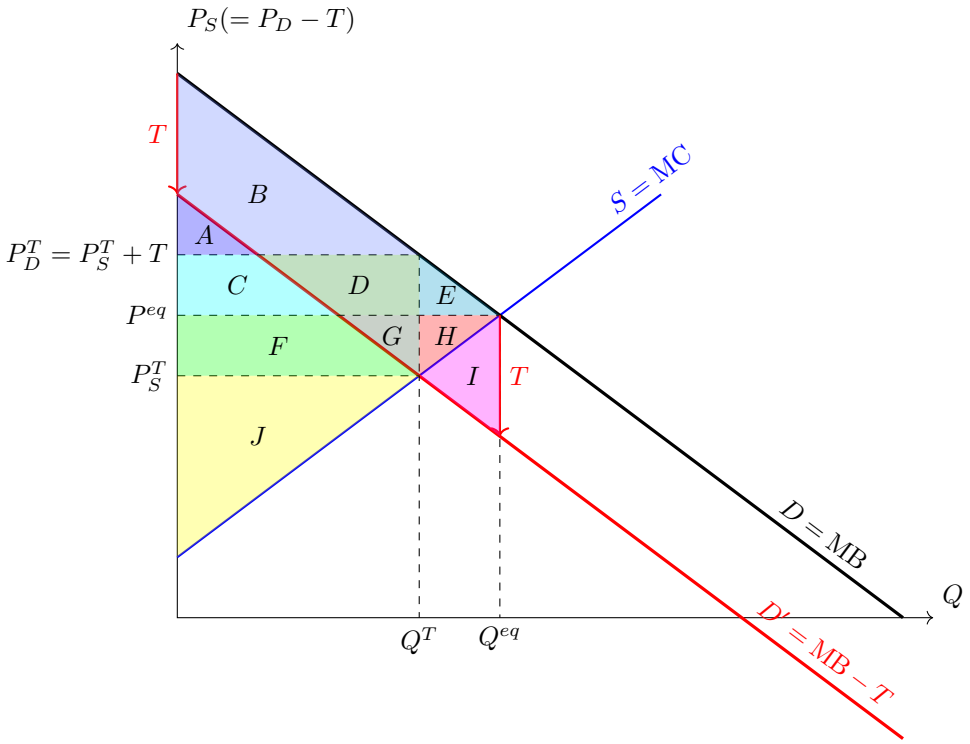
- A tax on consumers will cause a southwesterm shift on the supply curve. This is because for each quantity Q, the marginal benefit of consuming the Q-th unit is now $\text{MB}(Q) - T$ instead of $\text{MB}(Q)$. Therefore, the supply curve will shift upwards by T liras.
- As a result, the equilibrium will shift in the southwestern direction: the quantity traded under taxation will be $Q^T < Q^{eq}$ and the price that the producers receive will be $P_S^T < P^{eq}$.
- Note, however, that the price consumers pay will be higher than the price producers receive. This is because the consumers have to pay T liras to the government per each unit bought. Therefore, the price consumers pay in equilibrium is $P_D^T = P_S^T + T$. The (Q^T, P_D^T) point lies on the original demand curve. We calculate the consumer surplus based on the area between the original supply curve and P_D^T.[6]
- The tax revenue of the government (TR) is the quantity traded (Q^T) times the per unit tax (T). Therefoe, $\text{TR} = Q^T \cdot T$.

Let's investigate the figure.

[5] Is a sales tax (for instance, the value added tax) formally paid by the consumer or the producers? Unclear, and also, as we will see in a moment, it does not matter.

[6] Equivalently, we can calculate it as the area between the shifted demand curve and P_S^T. It would give the same answer.

Surplus and Deadweight Loss with Unit Tax T on Consumers



	Free Market	With Taxation
CS	$A + B + C + D + E$	$A + B$
PS	$F + G + H + J$	J
Tax Collected (TR)	0	$C + D + F + G$
Economics Surplus = CS + PS + TR	$A + B + C + D + E + F + G + H + J$	$A + B + J + C + D + F + G$
Maximum Economics Surplus	$A + B + C + D + E + F + G + H + J$	$A + B + C + D + E + F + G + H + J$
DWL	0	$E + H$

A couple of notes:

- Both CS and PS unambiguously decrease as a result of taxation. The price that consumers pay is larger than the free market price, and the price producers receive is smaller than the free market price.
- Once again, we are including the tax revenue in the economic surplus.
- There is some deadweight loss. Intuitively, the government still says "Every time a consumer and a producer make a trade, I demand T." When $\text{MB}(Q) - \text{MC}(Q) < T$, the parties of the transaction stop trading. The result is a DWL of $E + H$.
- The tax revenue is $C + D + F + G$. Even though the consumers are legally required to pay the tax, in equilibrium, the producers and consumers share the tax burden. $C + D$ is taken away from the **consumer surplus**, and $F + G$ is taken away from the **producer surplus**. Therefore, **even though one side of the market is required to pay the tax, both sides of the market share the tax burden**.

4.5 Tax Incidence

If you had a careful look at the figures representing taxes on consumers and taxes on producers, you may have realized by now: these figures are exactly the same. That is, CS, PS, TR and DWL in both cases are identical. In both cases, DWL is a triangle whose left side has a height of T. This is not a coincidence! **It does not matter who is legally required to pay the tax, the implications of a per unit tax is always the same.**

This bears the following question: "In any case, both parties share the tax burden. But **who pays the larger share of the tax burden?**" The answer to this question is: **"Whichever side of the market has lower elasticity."** You can convince yourself of this by drawing a very inelastic demand curve: you will see that the prices consumers pay increase almost as much as T. Alternatively, if the supply curve is very inelastic, the price producers receive decrease almost as much as T. (See Appendix B for an example.)

This actually makes a lot of sense. Consider a market with very inelastic demand, for instance, the market for cigarettes. (As you know, cigarettes are addictive, which makes it almost impossible for people to adjust their consumption habits in response to price.) Suppose the government increases the tax on cigarettes: it says "From now on, for every pack of cigarette sold, I will get 5 TLmore." Do you think Phillip Morris gets upset about this tax? Not at all. This is because they can increase the price of cigarettes by 5 TLand get almost the same quantity demanded, and the same profits. Th real losers of this policy is the consumers. (As a side note, this is also one of the reasons why governments like taxing cigarettes and alcohol: they can extract a lot of tax revenue out of such goods. Of course, this is not the only, or even primary, reason for taxing cigarettes. You need to wait for the chapter on *externalities* to hear about the other reasons.)

4.6 Subsidies to Producers

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a per unit sales subsidy on the producers in this market. From now on, for every unit that is sold, the producer who sells the good will receive an extra B liras from me."

Examples: agriculture markets, medical products.

What will happen with a subsidy on producers?

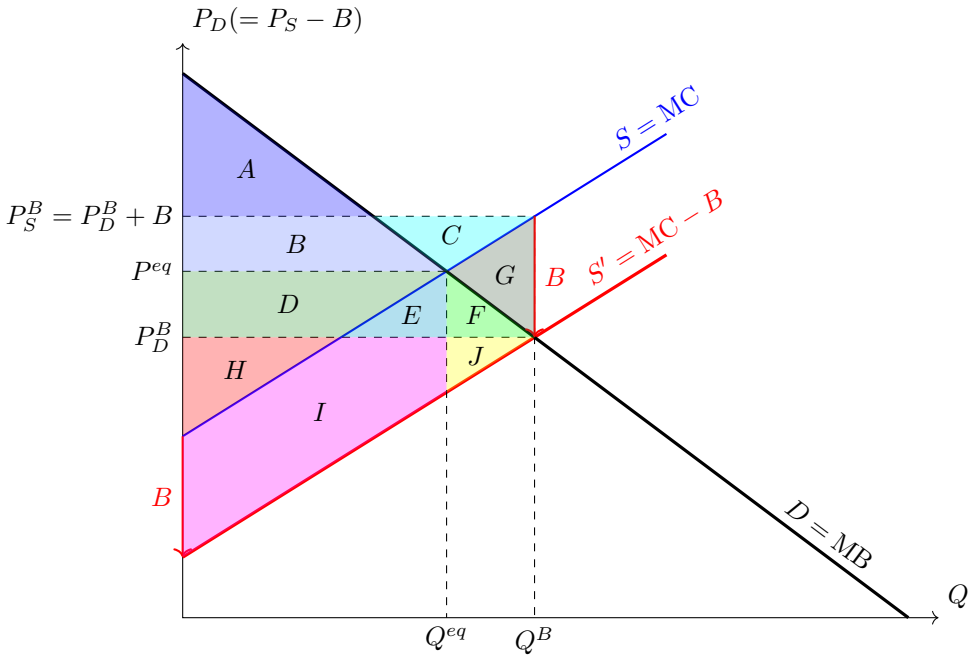
- Based on what we said in Chapter 5, a subsidy on producers will cause a southeastern shift on the supply curve. This is because for each quantity Q, the marginal cost of producing and selling the Q-th unit is now $\text{MC}(Q) - B$ instead of $\text{MC}(Q)$. Therefore, the supply curve will shift downwards by B liras.
- As a result, the equilibrium will shift in the southeastern direction: the quantity traded under taxation will be $Q^B > Q^{eq}$ and the price that the consumers pay will be $P_D^B < P^{eq}$.

- Note, however, that the price producers receive will be higher than the price consumers pay. This is because the producers receive an extra B liras deom the government per each unit sold. Therefore, the price producers receive in equilibrium is $P_S^B = P_D^B + B$. The (Q^B, P_S^B) point lies on the original supply curve. We calculate the producer surplus based on the area between the original supply curve and P_S^B.[7]
- The subsidy paid the government (TS) is the quantity traded (Q^B) times the per unit subsidy (B). Therefoe, TS $= Q^B \cdot B$.

Let's investigate the figure.

[7] Equivalently, we can calculate it as the area between the shifted supply curve and P_D^B. It would give the same answer.

Surplus and Deadweight Loss with Subsidy B to Producers



	Free Market	With Subsidy
CS	$A + B$	$A + B + D + E + F$
PS	$D + H$	$B + C + D + H$
Subsidy distributed by government (TS)	0	$B + C + D + E + F + G$
Economics Surplus $=$ CS $+$ PS $-$ TS	$A + B + D + H$	$A + B + D + H - G$
Maximum Economics Surplus	$A + B + D + H$	$A + B + D + H$
DWL	0	G

Notes:

- Both CS and PS unambiguously increase as a result of subsidies. The price that consumers pay is smaller than the free market price, and the price producers receive is larger than the free market price.
- We are subtracting the subsidy distributed in the economic surplus. This is because that subsidy does not fall from the sky: the government has to finance it somehow! (I was being very generous in the tax analysis by adding the tax revenue, not I am being equally harsh by subtracting the subsidy.)
- When the subsidy distributed is subtracted from the economic surplus, there is some deadweight loss. Intuitively, this is because of the following: the government says "Every time a consumer and a producer make a trade, I will give an extra B." When the gains from producing and consuming a unit is less than $-B$ (i.e., when $\text{MC}(Q) - \text{MB}(Q) < B$), the parties of the transaction have incentives to trade and share this extra money offered by the government. This results in **too much trade**. The result is a DWL of G.
- The subsidy distributed is $B+C+D+E+F+G$. Even though the producers are legal recipients of the subsidy, in equilibrium, the producers and consumers share the gains. Note that: $D+E+F$ is added to the **consumer surplus**: effectively, this is the subsidy that the consumers receive. $B+C$ is added to the **producer surplus**: this is the subsidy that producers receive. Therefore, **even though one side of the market is the legal recipient of the subsidy, both sides of the market benefit**.

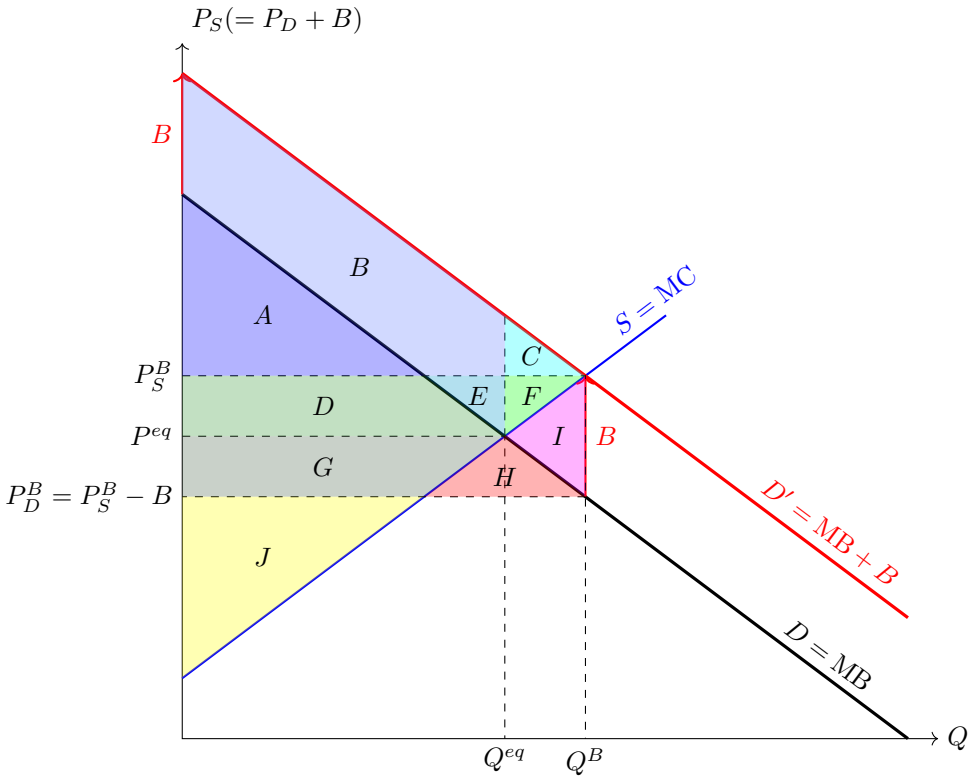
4.7 Subsidies to Consumers

Suppose that we have a (free market) competitive equilibrium (Q^{eq}, P^{eq}). Then, the government comes in and says the following: "I have decided to impose a per unit sales subsidy on the consumers in this market. From now on, for every unit that is consumed, the consumer who buys the good will receive an extra B liras from me."

By now, this should be obvious to you. I will save you from the burden by just presenting the figure. See the next page.

So... What have we learned? Overall, it is not a great idea for the government to intervene in a perfectly competitive market. Beginning with the next chapter, we start studying the deviations from the perfectly competitive market. Then, you will see that some of these conclusions will be overturned as well.

Surplus and Deadweight Loss with Subsidy B to Consumers



	Free Market	With Subsidy
CS	$A + D$	$A + D + G + H$
PS	$G + J$	$D + E + F + G + J$
Subsidy distributed by government (TS)	0	$D + E + F + G + H + I$
Economics Surplus $= \text{CS} + \text{PS} - \text{TS}$	$A + D + G + J$	$A + D + G + J - I$
Maximum Economics Surplus	$A + D + G + J$	$A + D + G + J$
DWL	0	I

Appendix

A An Example

Let's follow up with the example we had in the previous chapter. Consider a perfectly competitive market, where the market supply is given by

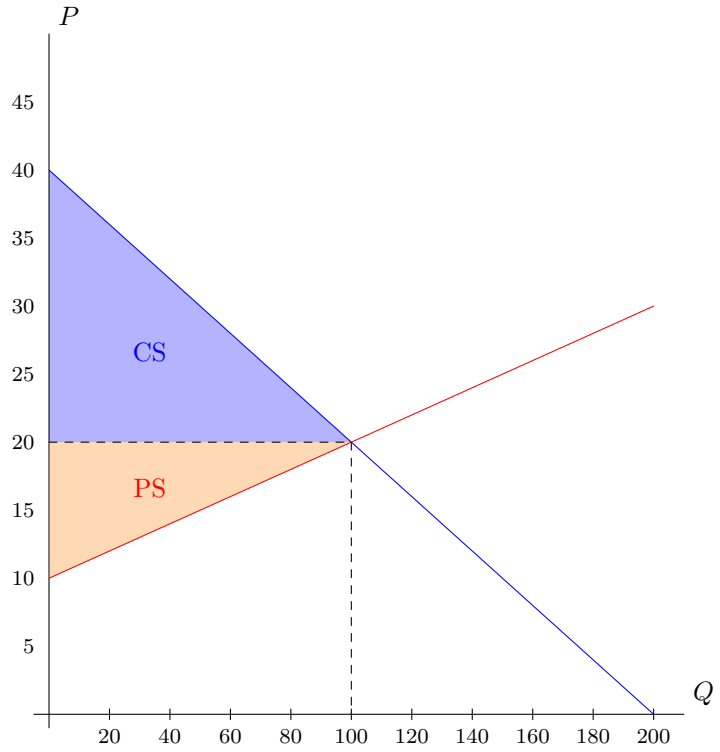
$$Q_S = 10P_S - 100 \tag{1}$$

and the market demand is given by

$$Q_D = 200 - 5P_D \tag{2}$$

We had already calculated in the previous chapter that in a free-market competitive equilibrium, $Q^{eq} = 100$ units and $P^{eq} = 20$ TL.

Now, let's find the the consumer surplus, producer surplus and the economic surplus without any government interventions at the competitive equilibrium. See the figure below.



In this figure, the blue area is the consumer surplus, the orange area is the producer surplus, and the sum of these areas is the economic surplus.

The consumer surplus is the area of a triangle with base 100 and height $40 - 20 = 20$. Thus,

$$CS = \frac{1}{2}100 \cdot 20 = 1000\text{TL}$$

The producer surplus is the area of a triangle with base 100 and height $20 - 10 = 10$. Thus,

$$PS = \frac{1}{2}100 \cdot 10 = 500\text{TL}$$

and the total surplus is

$$TS = CS + PS = 1000 + 500 = 1500\text{TL}$$

A.1 Surplus under Price Ceiling

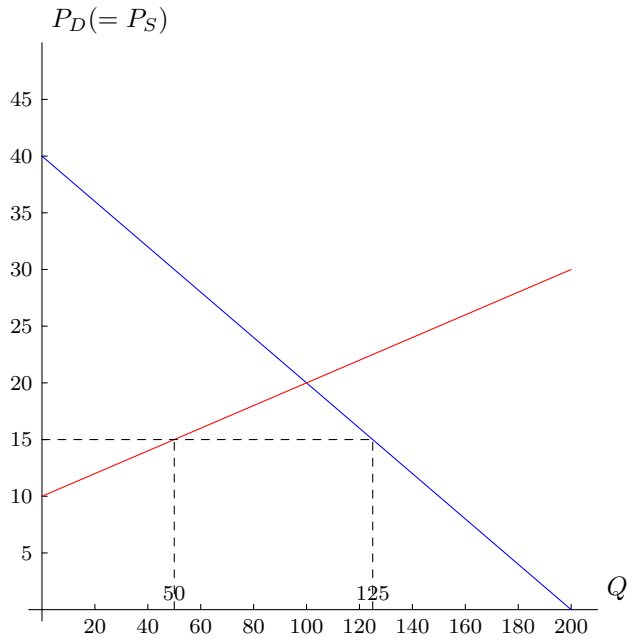
Now, suppose that the government sets a price ceiling of 15 TL/unit on this good. Under this policy, using (1), we can find the quantity producers are willing to supply:

$$Q_S^c = 10 \cdot 15 - 100 = 50$$

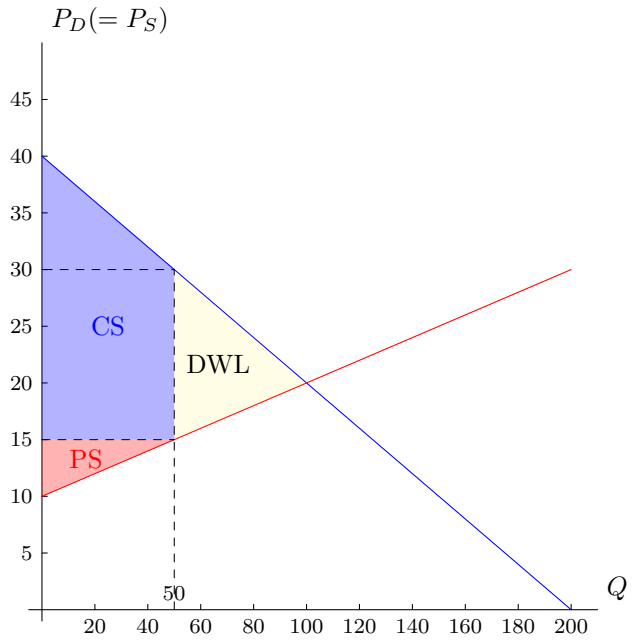
Using (2), the quantity demanded by consumers is:

$$Q_D^c = 200 - 5 \cdot 15 = 125$$

So, the quantity demanded is higher than quantity supplied. Unsurprisingly, a price ceiling creates a *shortage* (or *excess demand*). Without any price ceiling, the market interactions would push the price up, so that quantity demanded would decrease and quantity supplied would increase. But due to the price ceiling, the price stays at $P^c = 15$. The quantity traded is dictated by the smaller of Q_S^c and Q_D^c. Thus, there are $Q^c = 50$ units of the good traded, only a lucky minority of the consumers (50 out of 125) are able to buy the good. See the figure below.



To find the the consumer surplus, producer surplus, economic surplus and dead weight loss under price ceiling, we color the corresponding areas. In the figure below, the blue area is the consumer surplus, the red area is the producer surplus, the sum of CS and PS is the economic surplus, and the yellow-ish area is the deadweight loss.



The blue area is a trapezoid with bases $40 - 15 = 25$ and $30 - 15 = 15$, and height 50. Therefore,

$$\text{CS} = \frac{1}{2}(25 + 15) \cdot 50 = 1000\text{TL}$$

(Note: even though the consumer surplus stays the same, there are winners and losers from a price ceiling policy! Some lucky consumers manage to buy the good under shortage; they are the winners because they buy at a cheaper price. Some unlucky consumers cannot buy it due to a reduction in quantity supplied, they are the losers.)

The red area is a triangle with base 50 and height $15 - 10 = 5$. Therefore,

$$\text{PS} = \frac{1}{2}50 \cdot 5 = 125\text{TL}$$

and

$$\text{ES} = \text{CS} + \text{PS} = 1000 + 125 = 1125\text{TL}$$

Finally, the yellow-ish area is a triangle with base $30 - 15 = 15$ and height $100 - 50 = 50$. Therefore,

$$\text{DWL} = \frac{1}{2}15 \cdot 50 = 375\text{TL}$$

We also could have calculated the deadweight loss by taking the difference between ES without any government intervention and ES under price ceiling. That is: $\text{DWL} = 1500 - 1125 = 375\text{TL}$.

A.2 Surplus under Taxation

Now, assume that a unit tax of 3 TL/unit is imposed on the producers. We start by finding the equilibrium under taxation.

The impact of the taxation is that, now, the prices that the consumers face and the prices that the producers face are different. We will denote the price that producers face with P_S^t, quantity supplied with Q_S^t the price that consumers face with P_D^t, and the quantity demanded with Q_D^t. Note that the demand and supply equations still hold, but now with the respective prices:

$$Q_S^t = 10P_S^t - 100 \tag{3}$$
$$Q_D^t = 200 - 5P_D^t \tag{4}$$

Under the tax, the prices that producers face is 3 TL lower the the prices that consumer face, because they have to pay an extra 3TL to the government after the transaction is made.

$$P_S^t = P_D^t - 3 \tag{5}$$

Once again, we start by observing that $Q_S^t = Q_D^t = Q^t$ in equilibrium. Using this with (3) and (4) gives:

$$10P_S^t - 100 = 200 - 5P_D^t$$

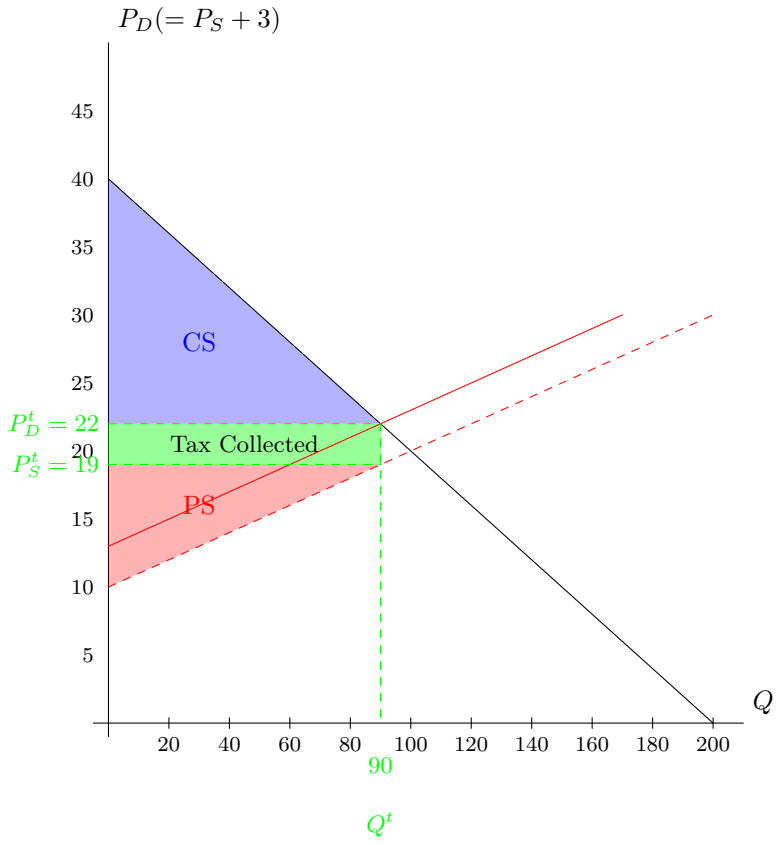
Substituting (5):

$$\begin{aligned} 10(P_D^t - 3) - 100 = 200 - 5P_D^t &\implies 10P_D^t - 130 = 200 - 5P_D^t \\ &\implies P_D^t = \frac{330}{15} = 22 \text{ TL/unit} \\ &\implies P_S^t = P_D^t - 3 = 19 \text{ TL/unit} \end{aligned}$$

And the quantity traded is

$$Q^t = 10P_S^t - 100 = 10 \cdot 19 - 100 = 90$$

See the graph below:



In this figure, the consumer surplus is the blue triangle and the producer surplus is the red triangle.

$$CS = \frac{1}{2}90 \cdot (40 - 22) = 810\text{TL}$$
$$PS = \frac{1}{2}90 \cdot (19 - 10) = 405\text{TL}$$

The tax collected by the government is simply the tax per unit traded times the quantity traded. That is:

$$\text{Tax revenue} = 3 \cdot Q^t = \cdot 90 = 270 \text{ TL}$$

You can also see that this is the are of the green rectangle.

Therefore, the economic surplus is:

$$ES = CS + PS + \text{Tax revenue} = 810 + 405 + 270 = 1485\text{TL}$$

(Note that we are including the tax revenue in the economic surplus. This corresponds to saying that the tax collected by the government is not "lost", the government has the ability to redistribute it back to consumers and firms in a way that creates welfare.)

The deadweight loss is:

$$DWL = \frac{1}{2} 3 \cdot (100 - 90) = 15\text{TL}$$

As before, you can also calculate DWL by taking the difference between ES without any government intervention and ES under taxation. That is: $ES = 1500 - 1485 = 15\text{TL}$.

As we discussed, these numbers would be the same if the tax was imposed on the consumer instead. That is, *it does not matter who is legally required to pay the tax, both sides of the market share the tax burden because the quantity traded and prices adjust.*

A.3 Tax Incidence

Now that we know both sides of the market share the tax burden, it is time to calculate how that burden is shared. There are two ways to think about this:

1. One way to calculate this would be noting the following. Without the tax, the price that consumers face would be $P^{eq} = 20$. With the tax, the price that consumers face is $P_D^t = 22$. Therefore, per unit traded, the consumers are paying an extra $22 - 20 = 2$ TL to the government. Given that the quantity traded under tax is $Q^t = 90$, the part of the tax burden that is paid by consumers is: $2 \cdot 90 = 180\text{TL}$.

   Similarly, without the tax, the price that producers face would be $P^{eq} = 20$. With the tax, the price that producers face is $P_D^t = 19$. Therefore, per unit traded, the producers are paying an extra $20 - 19 = 1$ TL to the government. Given that the quantity traded under tax is $Q^t = 90$, the part of the tax revenue that is paid by producers is: $1 \cdot 90 = 90\text{TL}$.

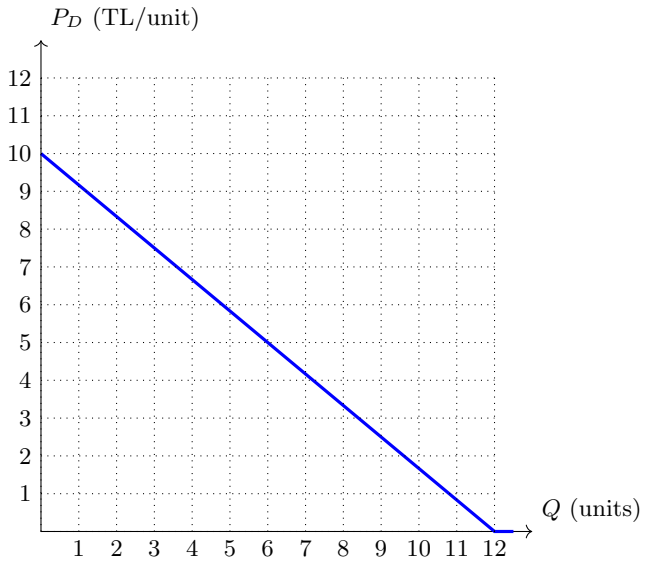
   All in all, given that the total tax revenue is 270 TL, we conclude that the consumers pay 2/3 of the total tax burden. This is even though the producers are legally paying the tax. This is because the demand is more inelastic than the supply (intuitively, the demand curve is steeper than the supply curve – see equations (**??**) and (**??**)).

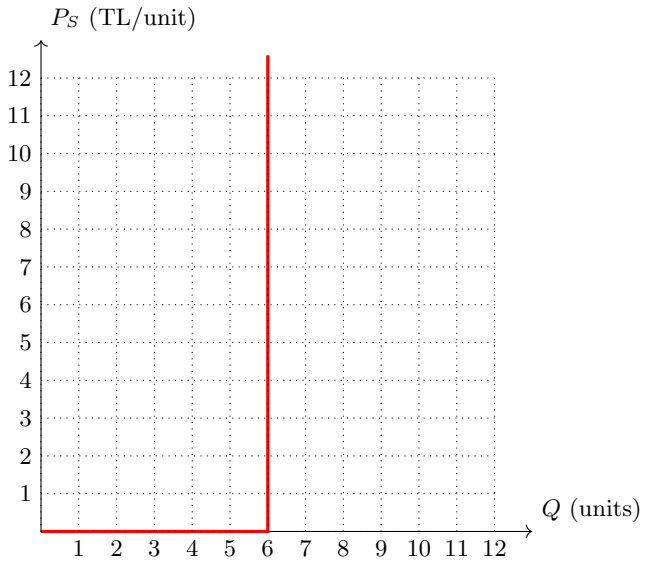
2. Graphically, we can split the green rectangle into two parts. Note that the part of the rectangle which corresponds to prices between 20 and 22 is "eating up" from the consumer surplus (just check the consumer surplus without government interventions to verify this). Thus, the part of the tax burden that is taken away from the consumer surplus is the upper two thirds of the rectangle. Given that the area of the rectangle is 270, the tax burden on consumers is $\frac{2}{3} \cdot 270 = 180\text{TL}$.

   Similarly, the part of the rectangle which corresponds to prices between 19 and 20 is "eating up" from the producers surplus (just check the producer surplus without government interventions to verify this). Thus, the part of the tax burden that is taken away from the producer surplus is the lower one third of the rectangle. Given that the area of the rectangle is 270, the tax burden on consumers is $\frac{1}{3} \cdot 270 = 90\text{TL}$.

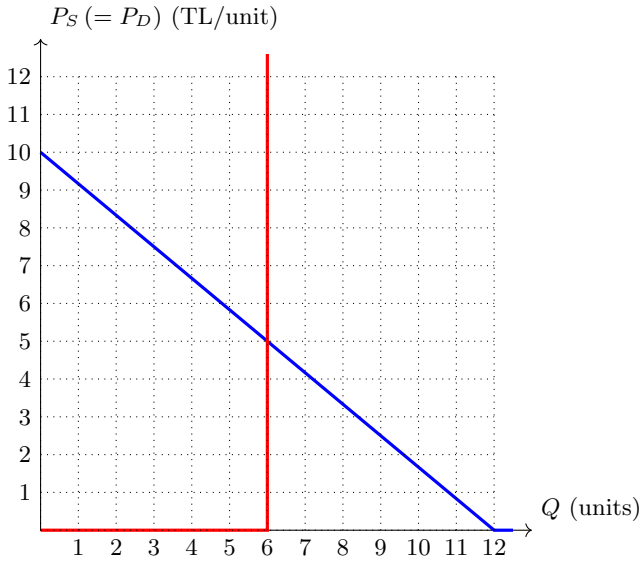
B Taxation under Inelastic Supply

Consider a market with the following market demand and market supply (note that the market supply is perfectly inelastic):





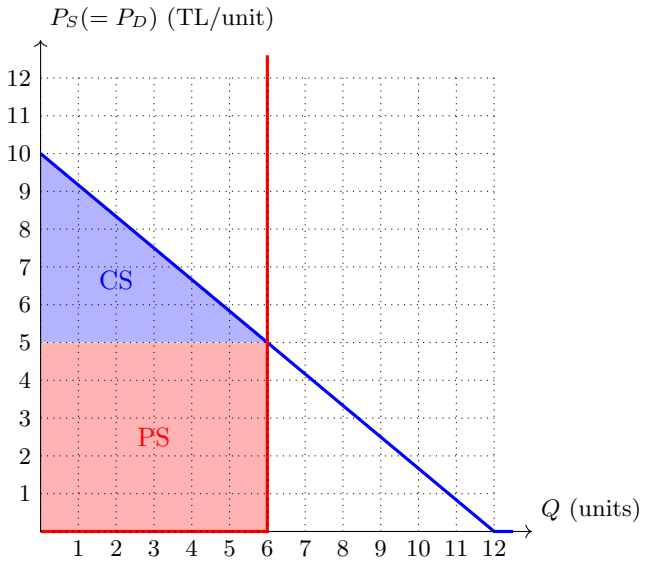
To find the free market equilibrium, we draw the demand and supply on the same graph:



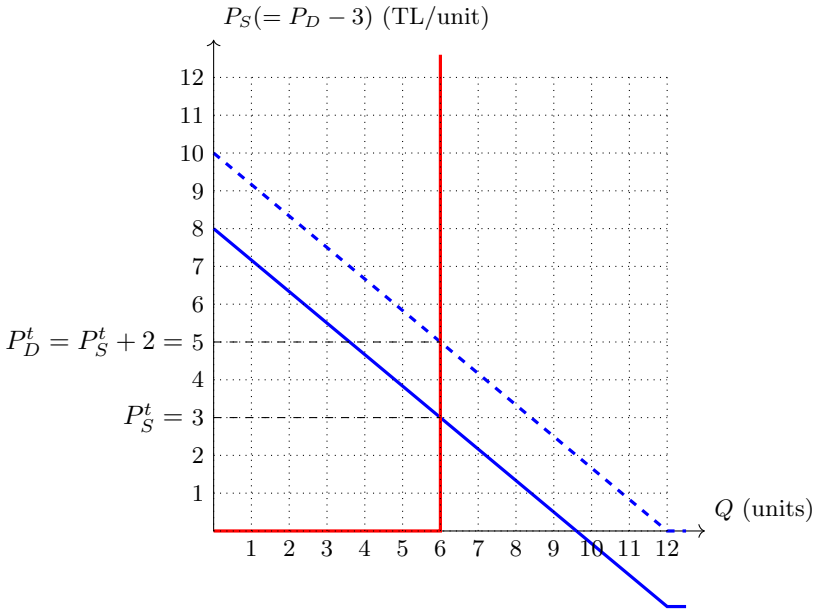
From the graph we observe that the equilibrium price is 5 TL/unit and the equilibrium quantity is 6 units.

To find the consumer surplus, producer surplus and the economic surplus (under free market conditions) at the equilibrium, from the figure below, we observe that:

$$\begin{aligned}
&\text{CS} = (1/2)(10-5)\cdot 6 = 15 \text{ TL} \\
&\text{PS} = 5\cdot 6 = 30 \text{ TL} \\
&\text{ES} = \text{CS} + \text{PS} = 15 + 30 = 45 \text{ TL} \ .
\end{aligned}$$

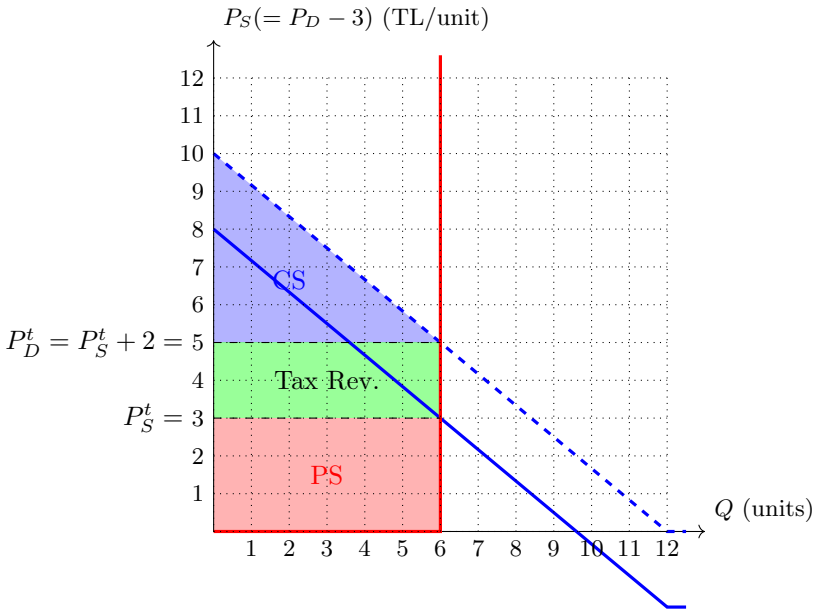


Now, suppose that a unit tax of 2 TL/unit is imposed on the consumers. From the graph below we observe that, the equilibrium price that the consumers face is $P_D^t = 5$ TL, the producers face is $P_S^t = 3$ TL, and the equilibrium quantity is $Q^t = 6$ units.



From the graph below, we can derive:

$$\begin{aligned} \text{CS} &= (1/2)(10-5)\cdot 6 = 15 \text{ TL} \\ \text{PS} &= 3 \cdot 6 = 18 \text{ TL} \\ \text{tax revenue} &= 2 \cdot 6 = 12 \text{ TL} \\ \text{ES} &= \text{CS} + \text{PS} + \text{tax revenue} = 15 + 18 + 12 = 45 \text{ TL} \end{aligned}$$



Since the realized economics surplus is equal to maximum economics surplus, there is no dead weight loss (there is no change in the quantity traded, hence the economic surplus should not change).

Note that, in this case, all of the tax burden is passed on to the producer. This is because supply curve is perfectly inelastic.

If a unit tax of 2 TL/unit is imposed on the producers instead, nothing would change. The answer will be the same as that we found in the case were the consumer was taxed (it does not matter which side is taxed).