# Chapter 2

Demand, supply and applications

# Flow of study in this chapter

› Demand, supply and equilibrium

We first try to understand the meaning of demand, supply and equilibrium. How consumers and producers react in a market and how price can be a signal for both parties.

› Elasticity

Commodities and services can be differently elastic. The implication on many studies forward will also be varied by their elasticity.

› Surplus

How to define what people gain from trade and lay out a framework to study who gains or loses when there is a change in a market.

› Market intervention

Learn how a political, economic institution can intervene price in a market, what is the implication and results for those actions.

Further reading can be found in Pindyck and Rubinfeld (2018), page 55-82 and 327-362

# Market

**Definition 2.1**

***Market*** *is a context where trade occurs. Buyers (consumers), sellers (producers), good or service and price are mandatory components in a market.*

Each component, mentioned above, in a market should be clearly identified because it defines market structure. For instance, varieties of pineapple markets can be

› Pineapple (fresh from the field) market.

› Canned pineapple market.

› International pineapple market

# Assumptions imposed

## › Static analysis

We are studying only a single change at a time. No intertemporal chain-reaction effects to be included.

## › Ceteris Paribus (other things being equal)

To reduce complications in our study, we only study a change in one variable at a time, while keeping others intact.

## › Perfect competitive market

General characteristics of a perfect competitive market is that there are many numbers of buyers and sellers, in which no single entity can take control over price or quantity. More information of perfect competitive market will be in the market structure section.

# (1) Definition

**Definition 2.2**

*Demand refers to **quantity** or amount of good or service demanded by consumers at different prices in given period of time.*

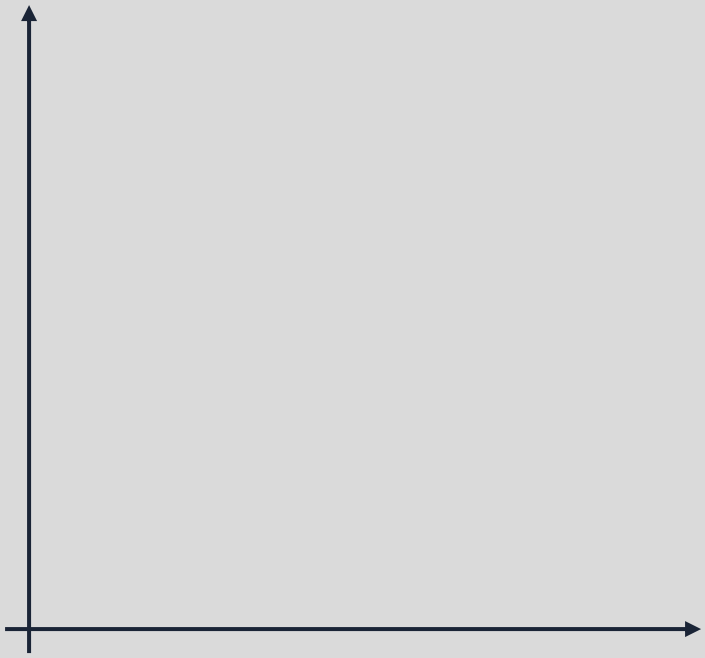
To constitute demand, it takes both **want** and **affordability**. Demand can be expressed in form of functions and equation as follows.

› $q_a = f(P)$

› $q_a = 10 - 2P$

From the equation above, we can create demand table and line.

# (2) Table, line and law of demand



| $P$ | $q_a$ |
|---|---|
| 0 | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**Definition 2.3**

***Law of Demand*** *is a claim that when price of a goods or service rises, its quantity demanded will fall and vice versa, when all other factors that can affect demand are held constant.*

# (3) Price effect

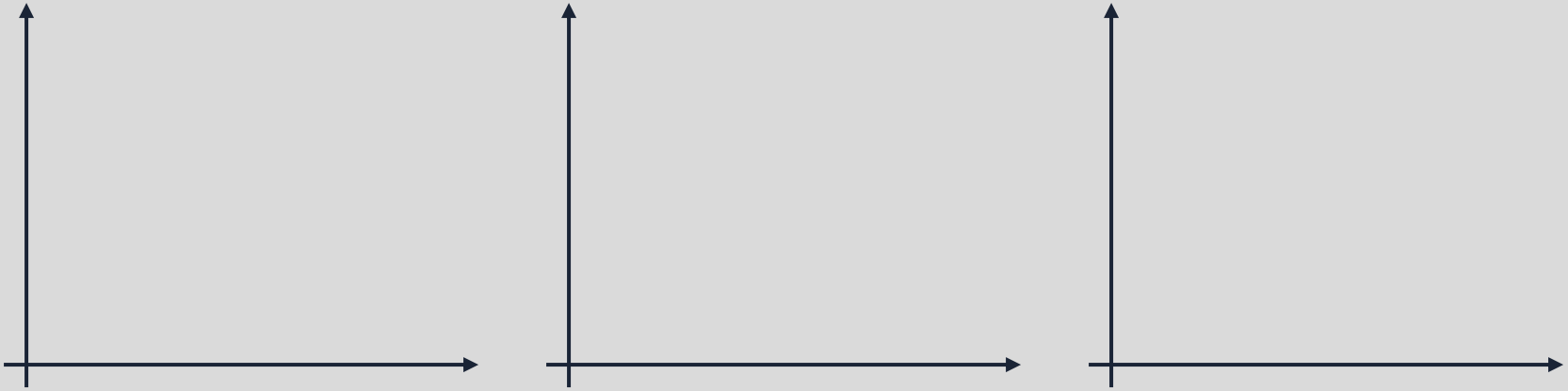
When price changes and affects quantity demanded, the result is called **price effect** (PE) which consists of two sub-effects.

› **Substitution effect** (SE) is the effect of relative price of substitutable good. For example, if A and B are substitutable and price of good A increases (decreases), good B will relatively become cheaper (more expensive) comparing to the relative price before price change.

› **Income effect** (IE) is the effect of consumers' real income. For example, if price of good A rises (drops), consumers are considered become poorer (richer) because they lose (gain) purchasing power.

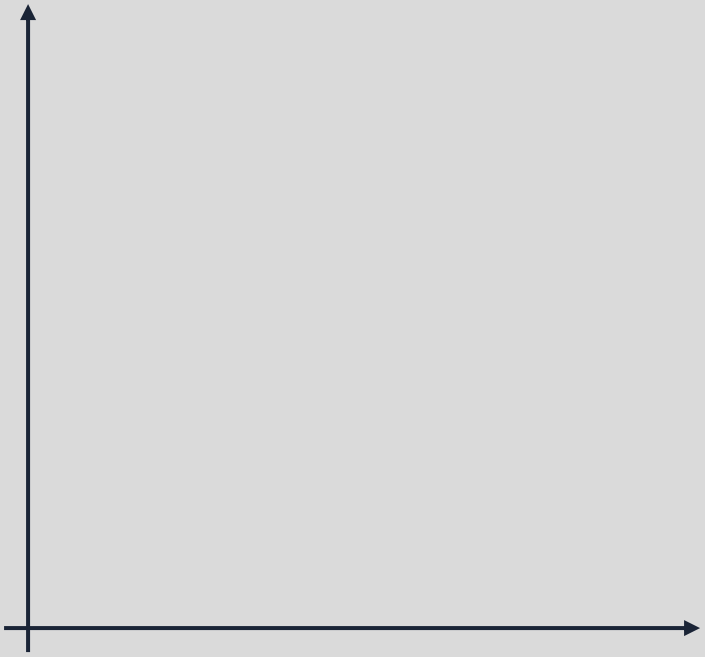
# (4) Individual and market demand

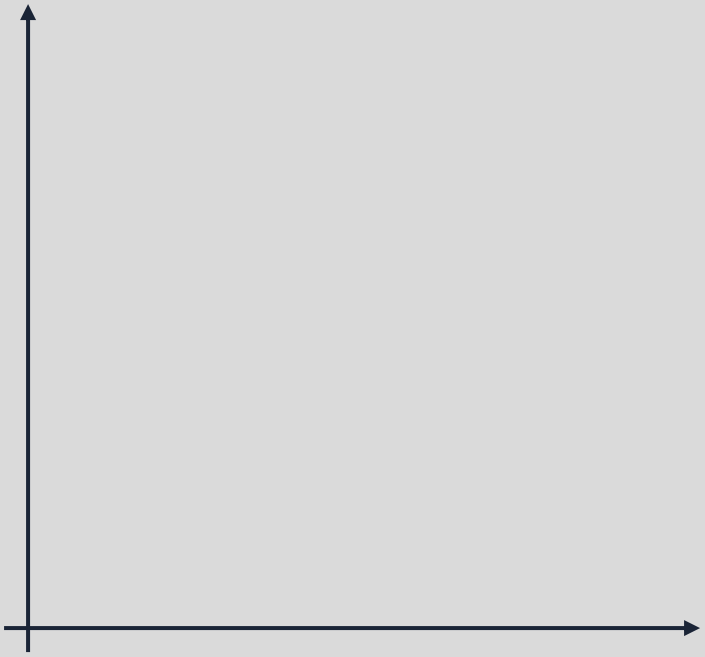
| $P$ | $q_a$ | $q_b$ | $Q$ |
|---|---|---|---|
| 0 | 12 | 20 | |
| 1 | 10 | 16 | |
| 2 | 8 | 12 | |
| 3 | 6 | 8 | |
| 4 | 3 | 4 | |
| 5 | 0 | 0 | |



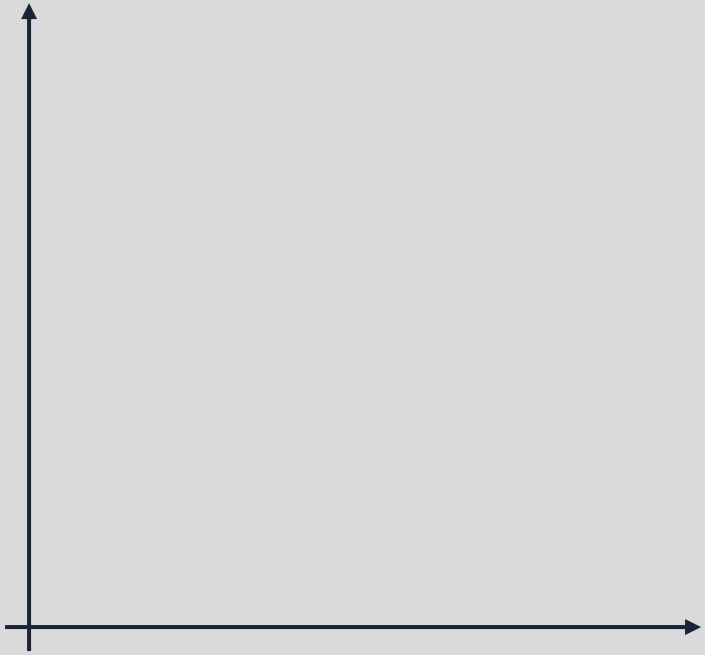
# (5) Demand move and shift

Changes in demand can be divided into 2 cases: (1) Moving along the curve, caused by changes in price (2) Shifting demand, caused by external factors that are not price.





# (6) Demand determiners



In which direction do these factors need to shift to in order to shift market demand to the right or increasing demand.

› Consumer income

› Consumer preference

› Price of complementary goods

› Price of substitutable goods

› Price speculation

# (7) Other types of demand

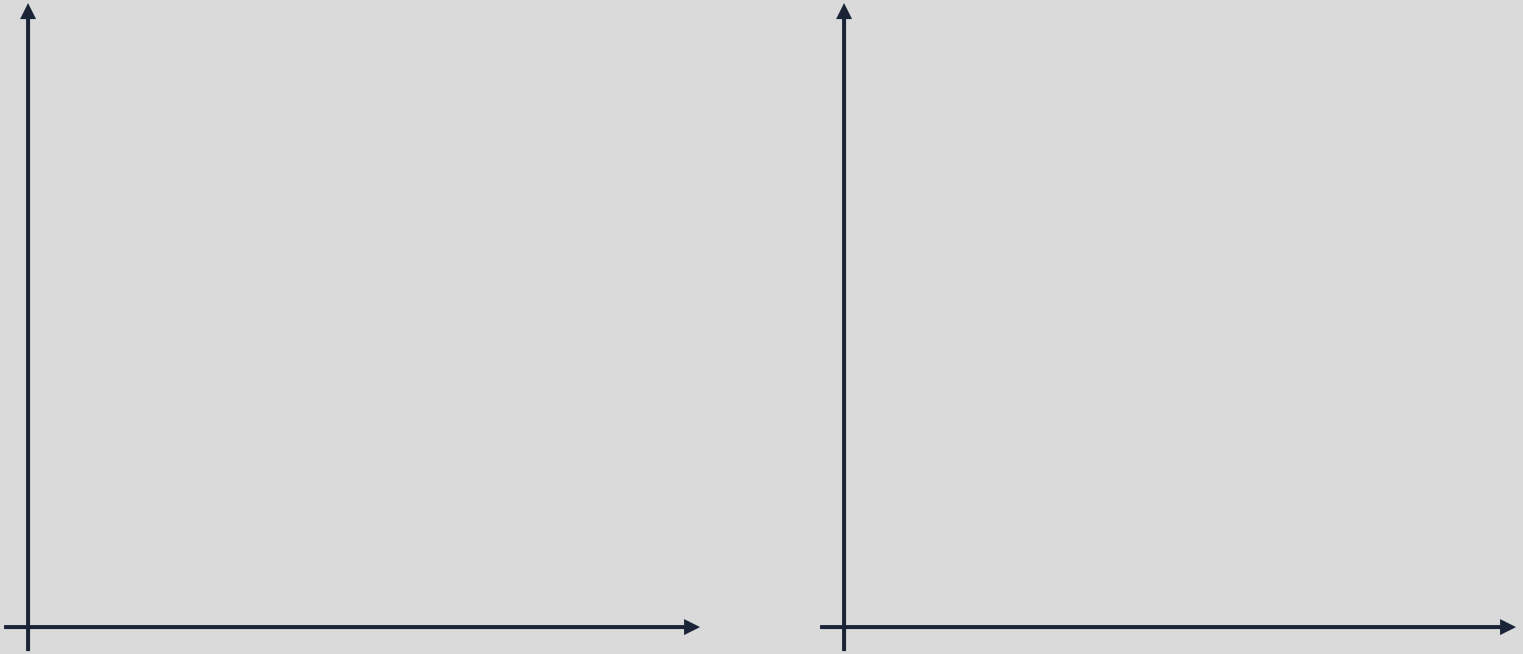
Demand can be plotted against other variables. If income replaces price, we call it **income demand**. However, income demand for normal goods and inferior goods are different.

**Definition 2.4**

***Inferior goods*** *are commodities or services which demand decreases when consumer income rises, or vice versa, unlike normal goods for which the opposite is observed.*

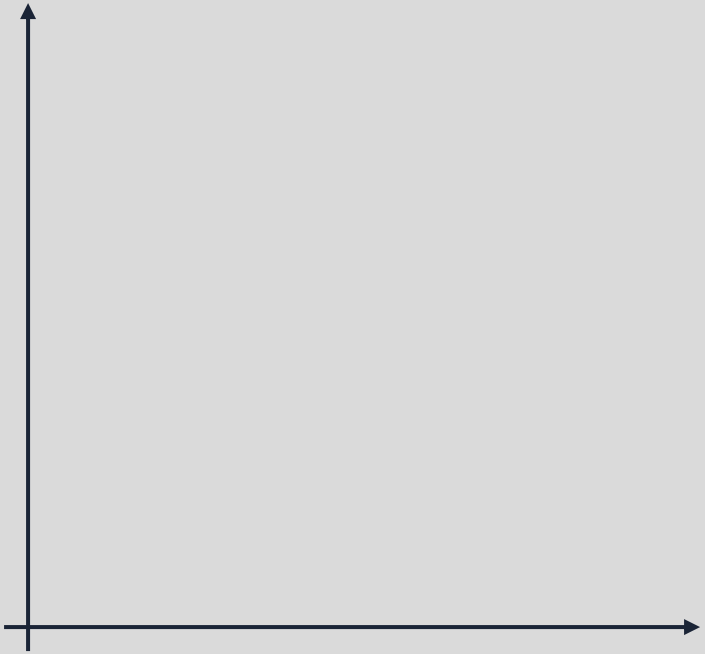
# (7) Other types of demand

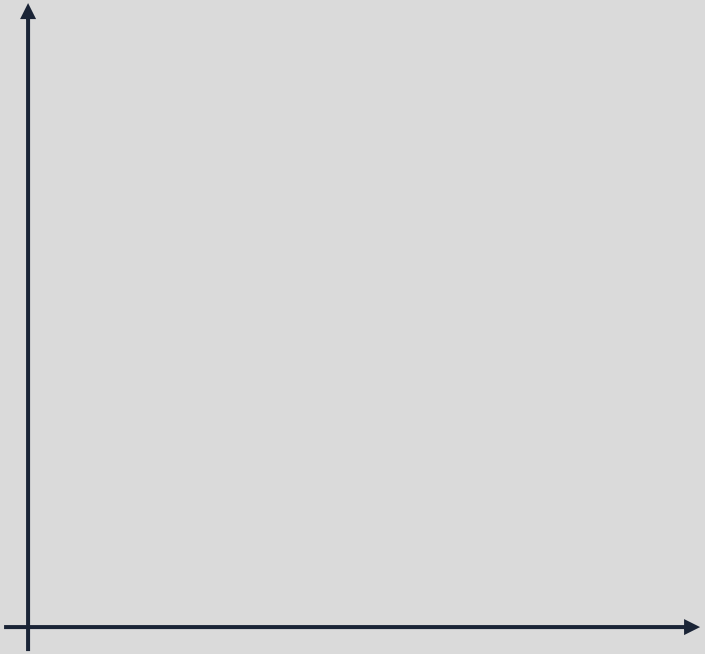
Now let's plot income demand for normal goods on the left and inferior goods on the right.



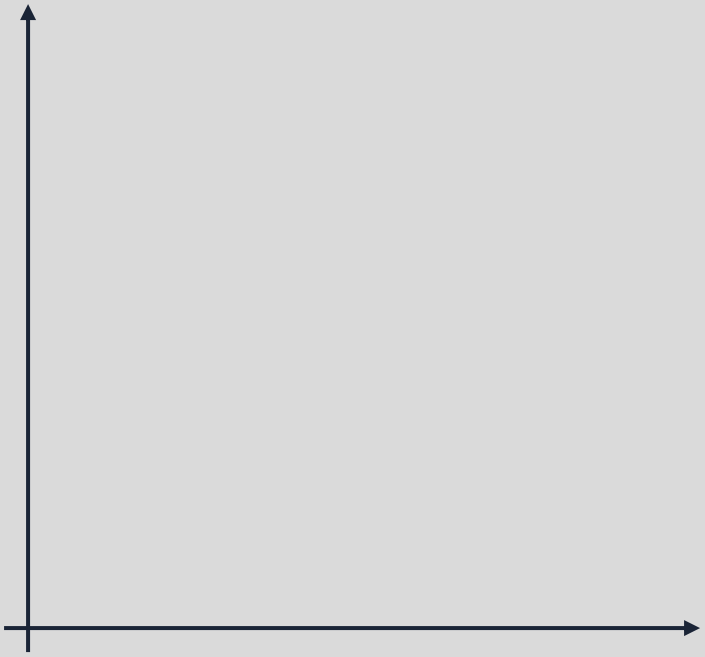
# (7) Other types of demand

Demand for A can be plotted with price of B (different commodities). These goods can be both **substitute** or **complementary**.





# (7) Other types of demand



Otherwise, two goods can be non-related at all.

How would demand for A and price of B be plotted?

# (1) Definition

**Definition 2.5**

*Supply refers to **quantity** or amount of good or service supplied by producers at different prices in given period of time.*

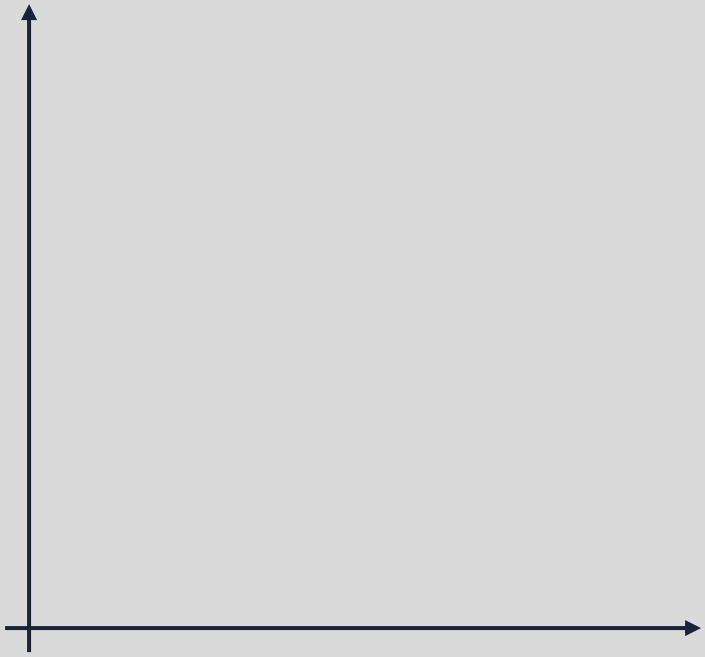
Supply can be expressed in form of functions and equation as follows, similar to demand.

› $q_k = f(P)$

› $q_k = 3P$

From the equation above, we can create supply table and line.

# (2) Table, line and law of supply



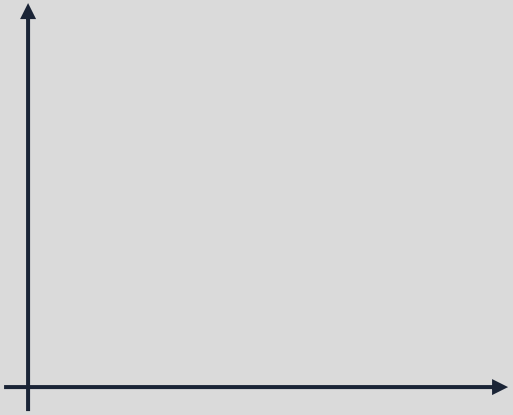
| $P$ | $q_k$ |
|---|---|
| 0 | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

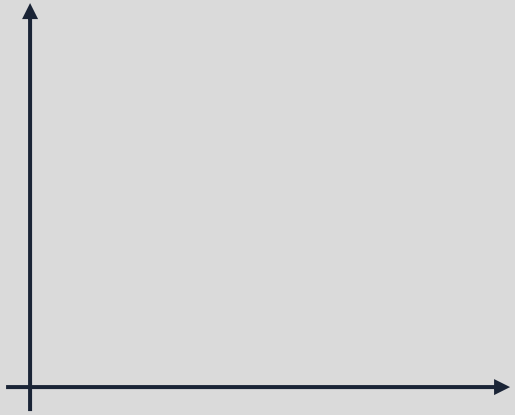
**Definition 2.3**

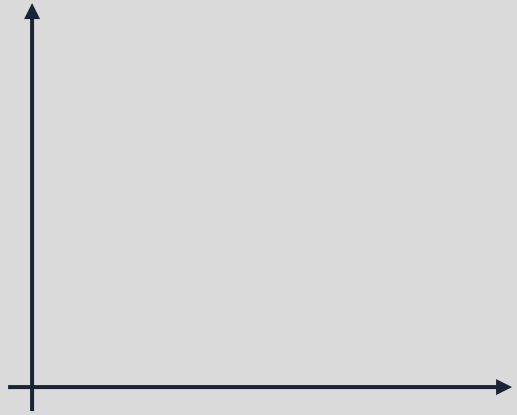
***Law of Supply*** *is a claim that when price of a goods or service rises, its quantity supplied will also rises and vice versa, when all other factors that can affect supply are held constant.*

# (3) Individual and market supply

| $P$ | $q_k$ | $q_l$ | $Q$ |
|---|---|---|---|
| 0 | 0 | 1 | |
| 1 | 3 | 3 | |
| 2 | 6 | 5 | |
| 3 | 9 | 7 | |
| 4 | 12 | 9 | |
| 5 | 15 | 11 | |







# (4) Supply move and shift

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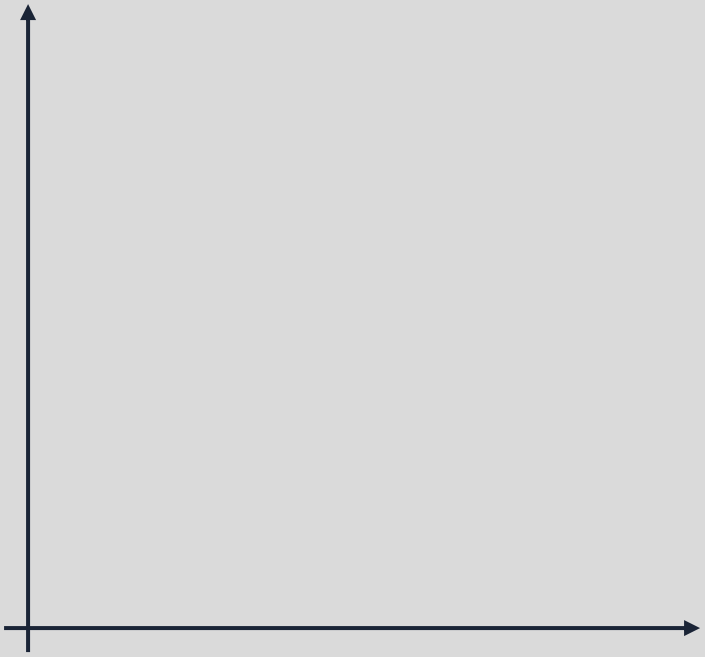
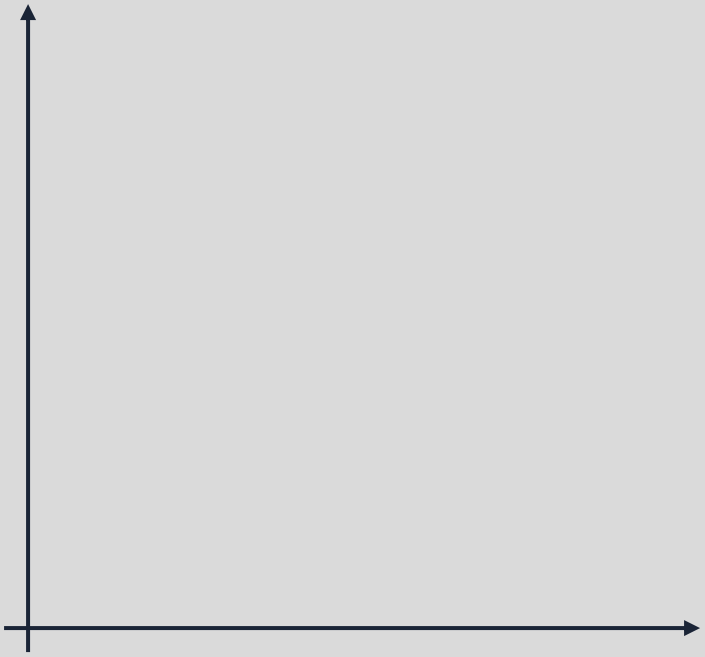
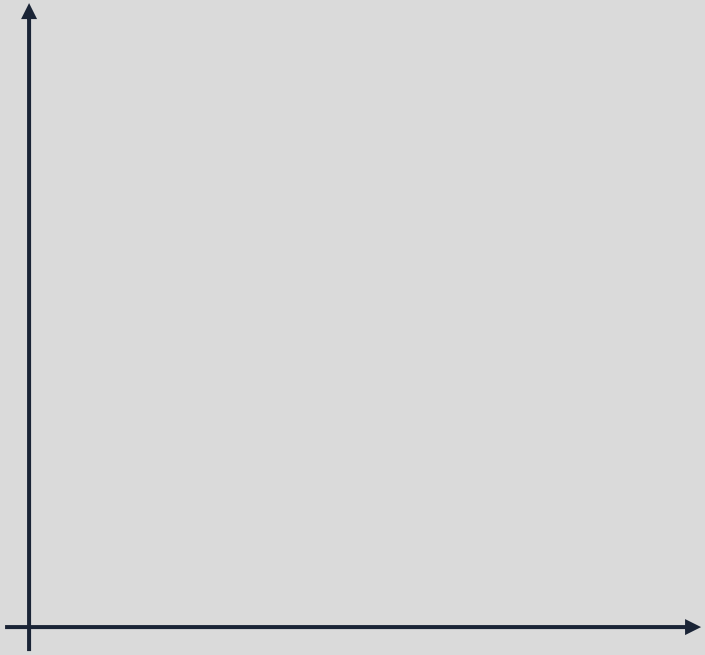




# (5) Supply determiners



In which direction do these factors need to shift to in order to shift market supply to the right or increasing supply.

› Factors of production price

› Technological progress

› Number of sellers

› Price speculation

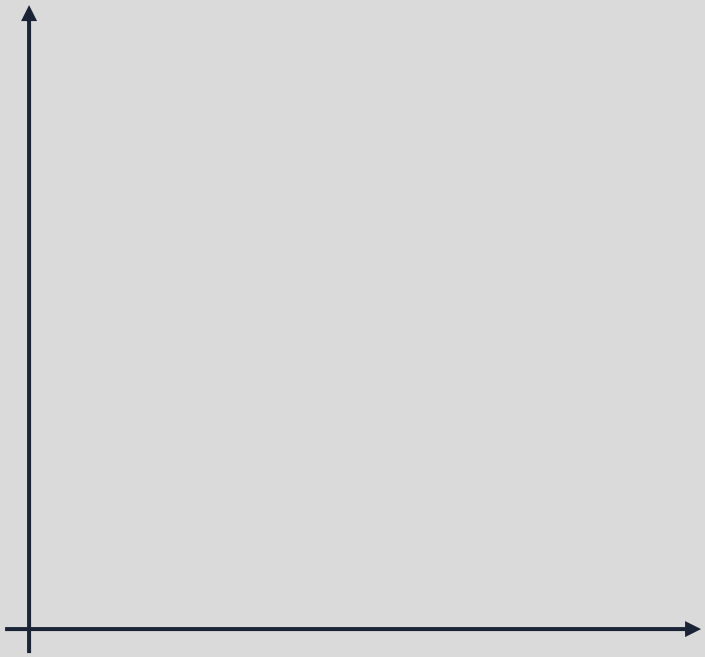
# (1) Definition

**Definition 2.6**

*There exists equilibrium price and quantity in a market, when quantity demanded and supplied are equal. Without exogenous force, equilibrium price and quantity remain stable.*

At the equilibrium, Q is the total quantity traded in a market within a period of time at price P.

# (1) Definition



. Try solving for the equilibrium of this system of equations.

› $Q_d = 10 - 2P$

› $Q_s = 3P$

The solution can be plotted into a graph on the left.

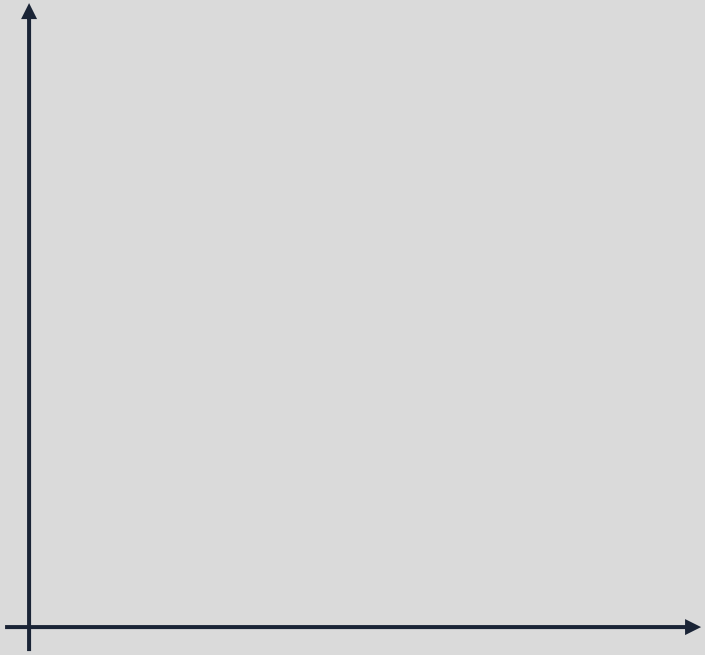
# (2) Price change

If price is temporarily fluctuated 'other things being equal', it may cause excess demand or supply, but the market would adjust itself and return to its original position.

**Definition 2.7**

***Excess demand (supply)*** *is the quantity demanded (supplied) exceeded equilibrium quantity at equilibrium price.*

# (2) Price change

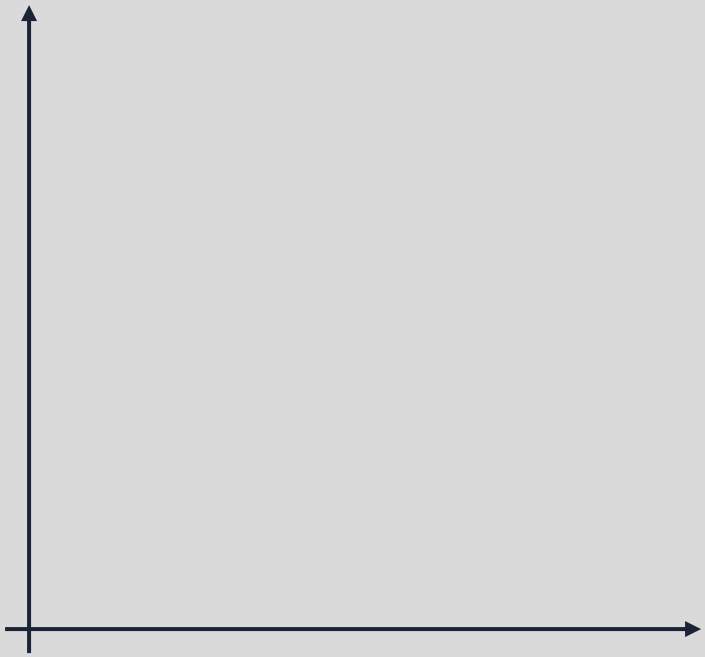


Let's see what would happen when price drops.

› Will there be excess demand or supply?

› How would the market adjust and why?

# (2) Price change



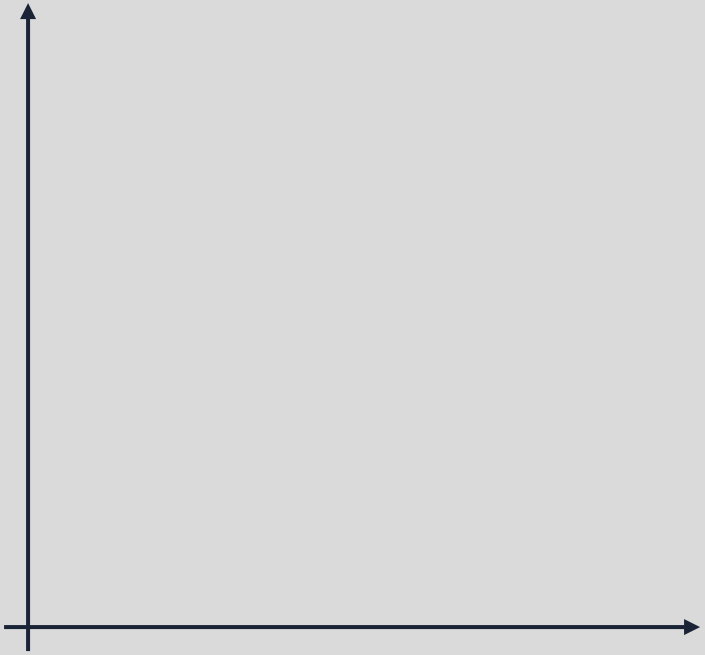
Let's see what would happen when price hike.

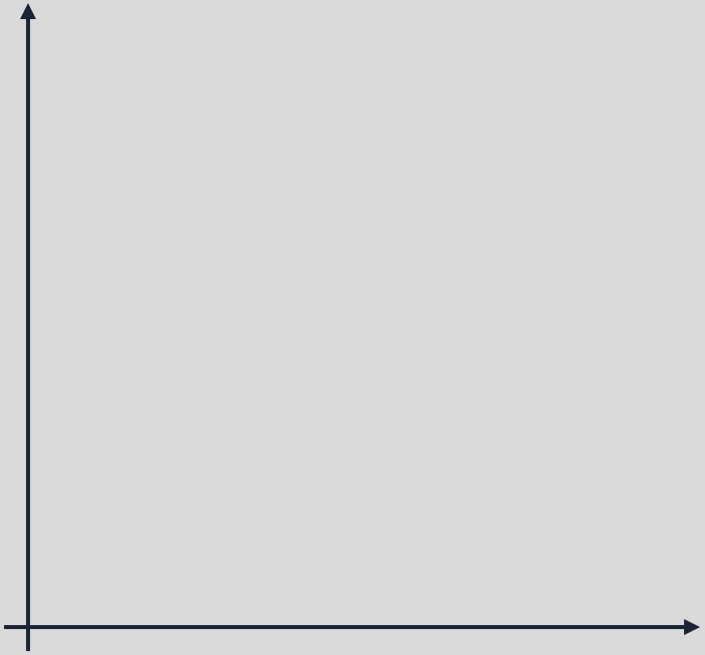
› Will there be excess demand or supply?

› How would the market adjust and why?

# (3) Shifting the equilibrium

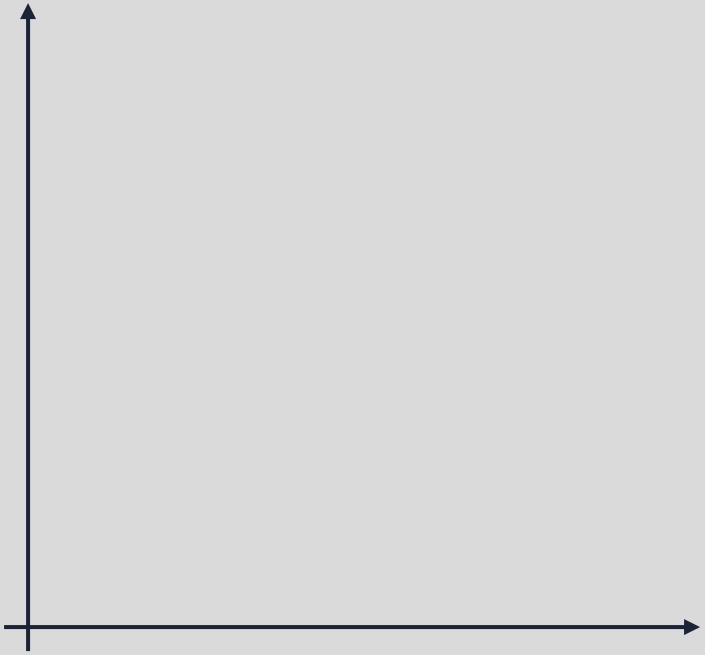
Now on the other hand if an external factor causes **demand shifts**, how would it affect equilibrium price when **demand** increase or decrease?

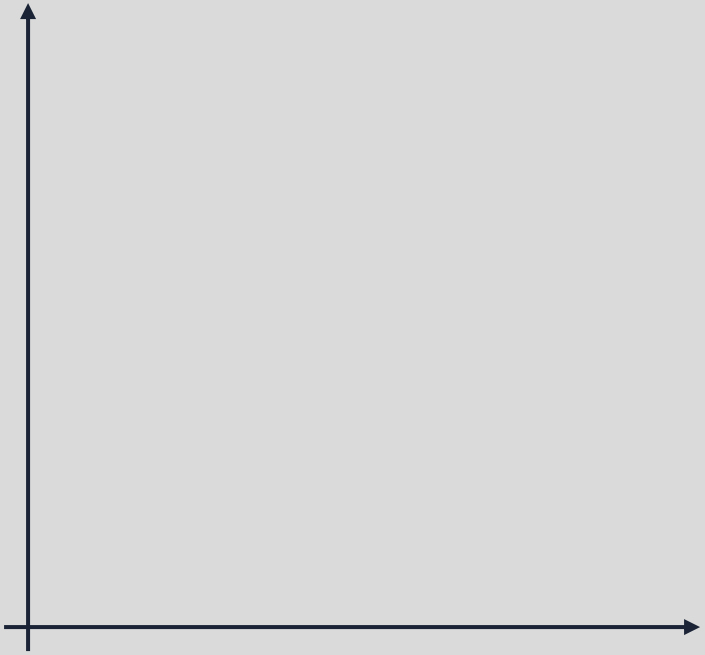




# (3) Shifting the equilibrium

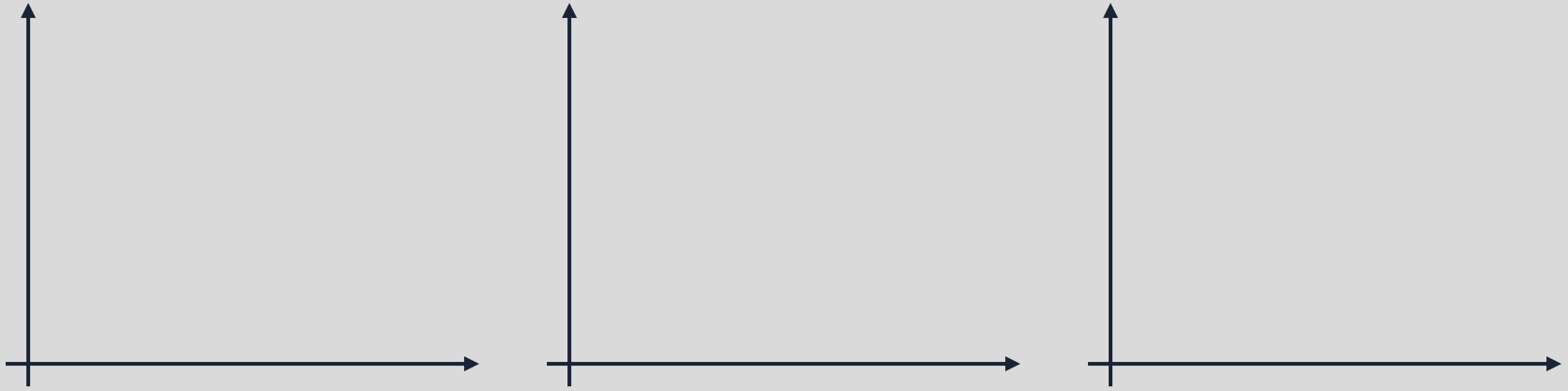
Again, if an external factor causes **supply shifts**, how would it affect equilibrium price when **supply** increase or decrease?





# (3) Shifting the equilibrium

We have further scenarios which include (1) Both demand and supply increase. (2) Both demand and supply decrease (3) Demand surges but supply drops (4) Supply surges but demand drops.



You should try shifting the rest of the scenarios. A point for this topic is to show that we focus on direction based on an economic explanation, rather than precise size of the effects.

# (1) General definition

Since economists mostly interested in price change and price determination from equilibrium, problems arise when they try to compare changes in different markets.

Supposed that there are two markets of interest, fuel oil and mobile phones market, both markets price drop 20 baht equally per unit. We can immediately see that quantity change in two markets would respond differently because there is a big gap in present prices between two goods.

**Definition 2.8**

***Elasticity*** *is a measure of sensitivity of one variable variable to a change in another variable. General formula takes the form of*

$$\varepsilon = \frac{\%change\ in\ dependent\ variable}{\%change\ in\ independent\ variable}$$

# (2) Price elasticity of demand

We apply the concept, then we can measure the elasticity of demand by using the ratio below.

## Definition 2.9

***Price elasticity of demand*** *is percentage change in quantity demanded for 1 percent of price increase.*

› $\varepsilon_d = \frac{\%change\ in\ quntity\ demanded}{\%change\ in\ price} = \frac{\%\Delta Q_d}{\%\Delta P}$

We can measure both point and arc elasticity of demand respectively.

› Point : $\varepsilon_d = \frac{P}{Q} \cdot \frac{\Delta Q}{\Delta P} = \frac{P}{Q} \cdot \frac{Q_2 - Q_1}{P_2 - P_1}$

› Arc : $\varepsilon_d = \frac{P_2 + P_1}{Q_2 + Q_1} \cdot \frac{\Delta Q}{\Delta P} = \frac{P_2 + P_1}{Q_2 + Q_1} \cdot \frac{Q_2 - Q_1}{P_2 - P_1}$

# (2) Price elasticity of demand

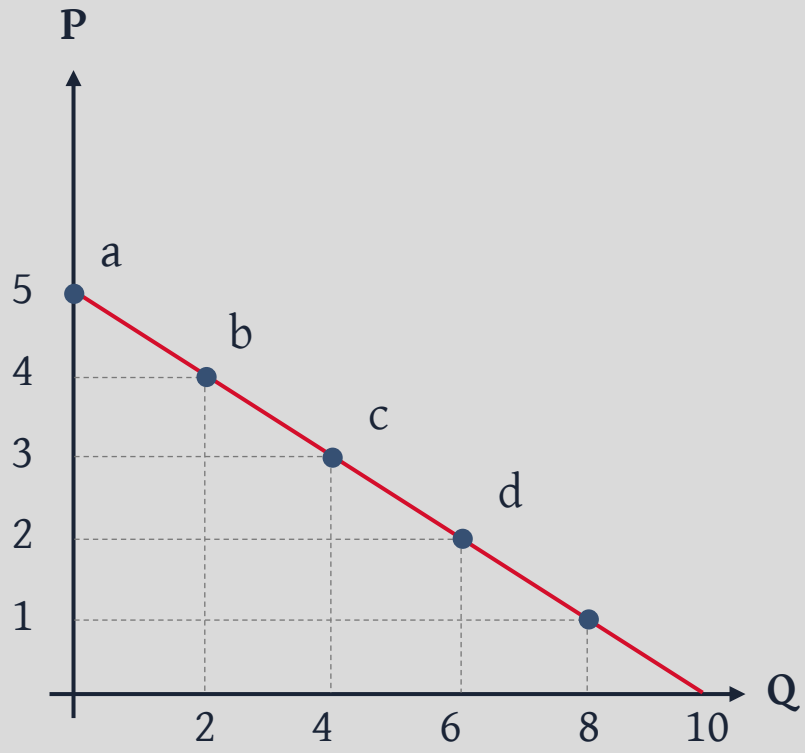



Figure out **point** elasticity on each coordinate.

› $\varepsilon_{d(\mathrm{a})} =$

› $\varepsilon_{d(\mathrm{b})} =$

› $\varepsilon_{d(\mathrm{c})} =$

› $\varepsilon_{d(\mathrm{d})} =$

# (2) Price elasticity of demand

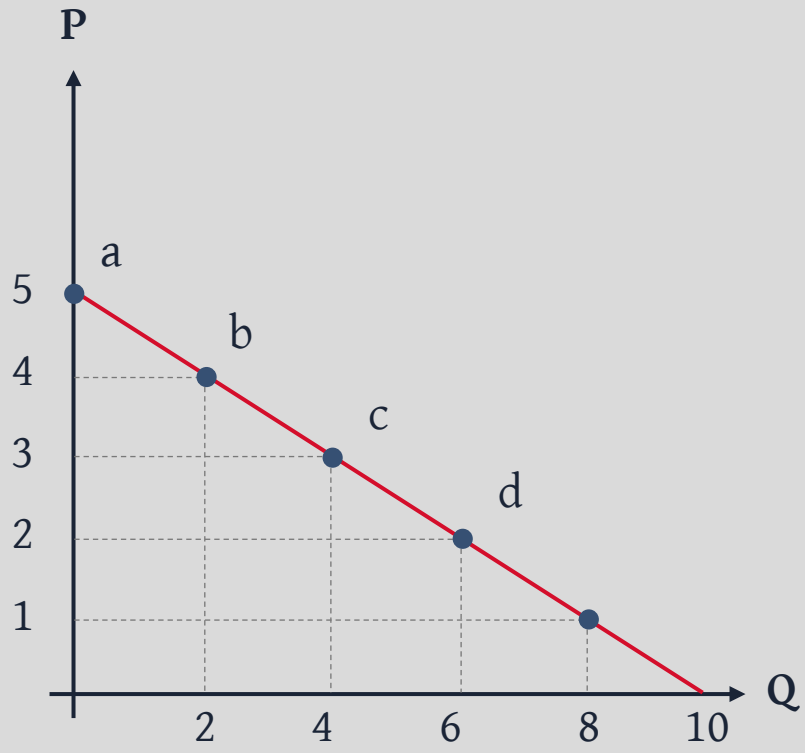



Figure out **arc** elasticity on each interval.

› $\varepsilon_{d(\text{ab})} =$

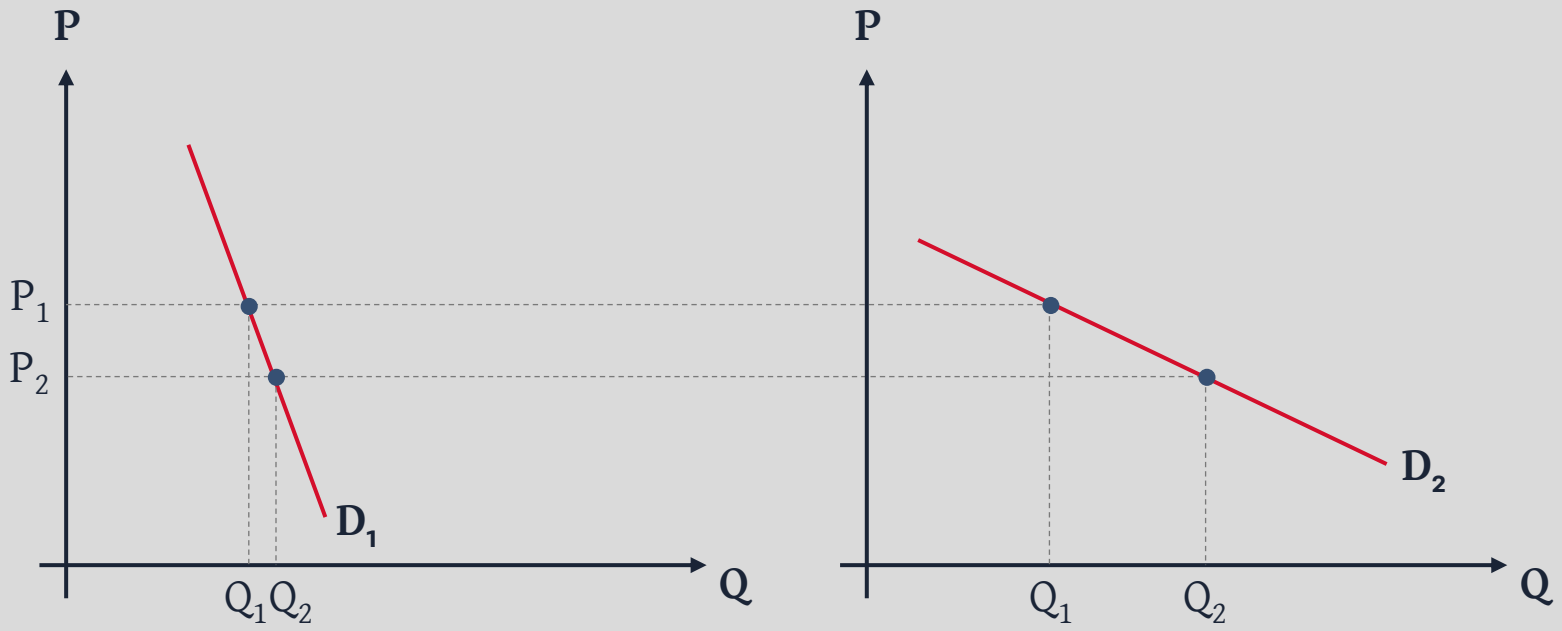
› $\varepsilon_{d(\text{bc})} =$

› $\varepsilon_{d(\text{cd})} =$

› $\varepsilon_{d(\text{ac})} =$

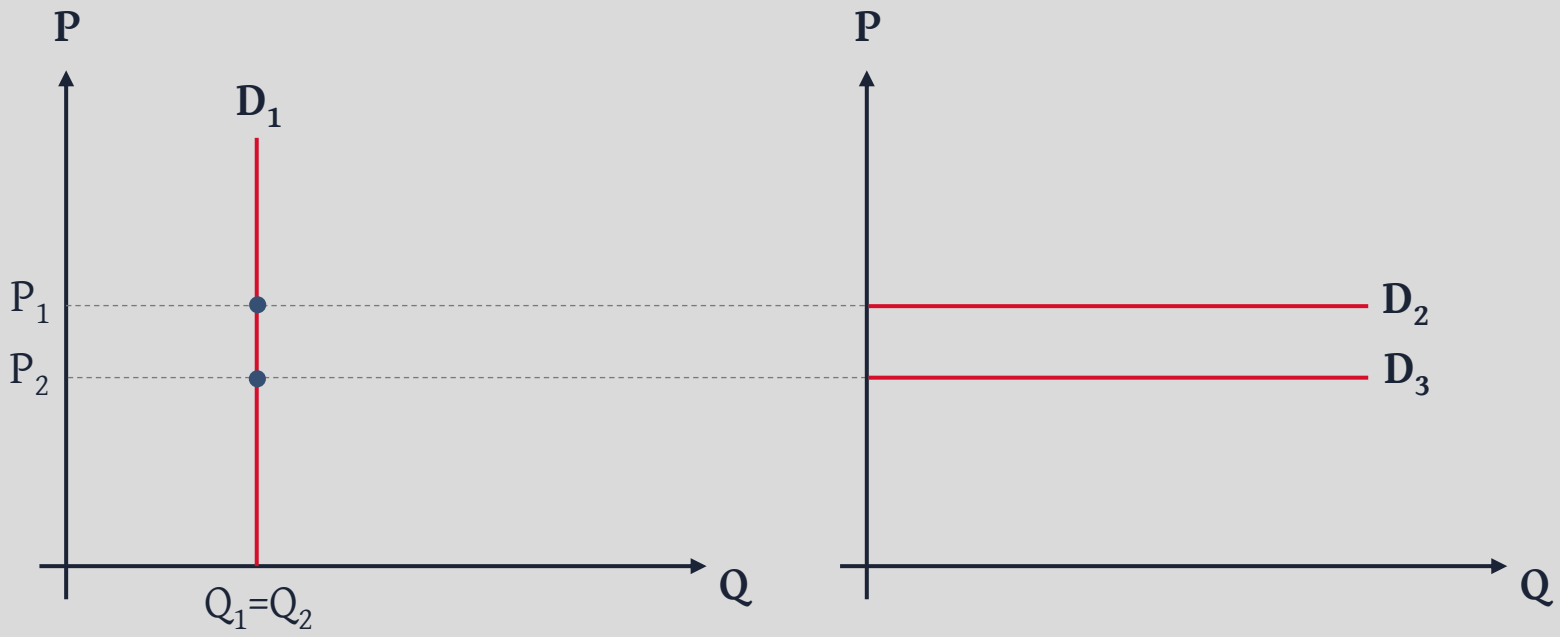
# (2) Price elasticity of demand

Relative elasticity of demand can be defined by slope, with an assumption that two goods are comparable meaning that their prices are in quite equal range.



# (2) Price elasticity of demand

Some goods are either perfectly elastic or inelastic.



# (2) Price elasticity of demand

| Commodities | $\varepsilon_d$ |
|---|---|
| Cigarette | -0.06 |
| Electricity (for accommodations) | -0.13 |
| Rice | -0.15 |
| Pesticide | -0.21 |
| Express toll | -0.29 |
| Fuel oil (imported) | -0.60 |
| Rice whiskey | -1.31 |
| Vehicle and components (imported) | -1.52 |

Which direction of these determiners make demand inelastic?

› Number of substitutable goods

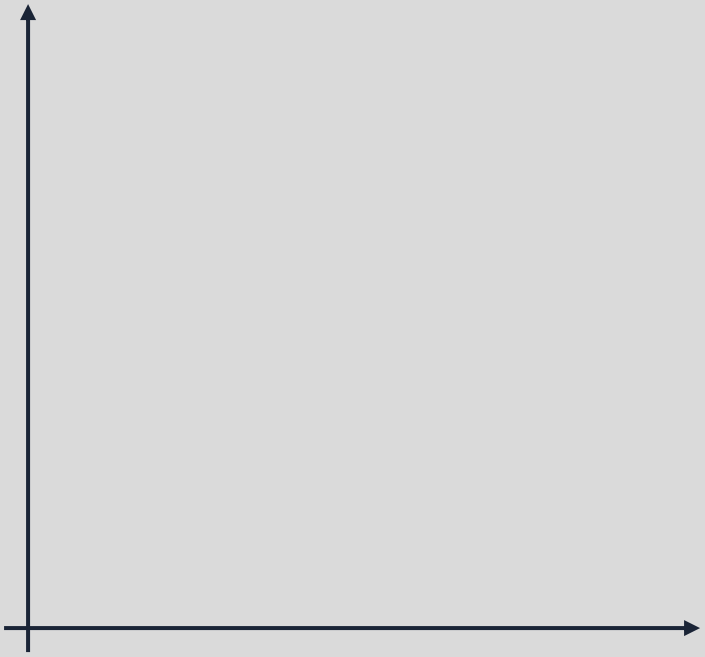
› Necessity

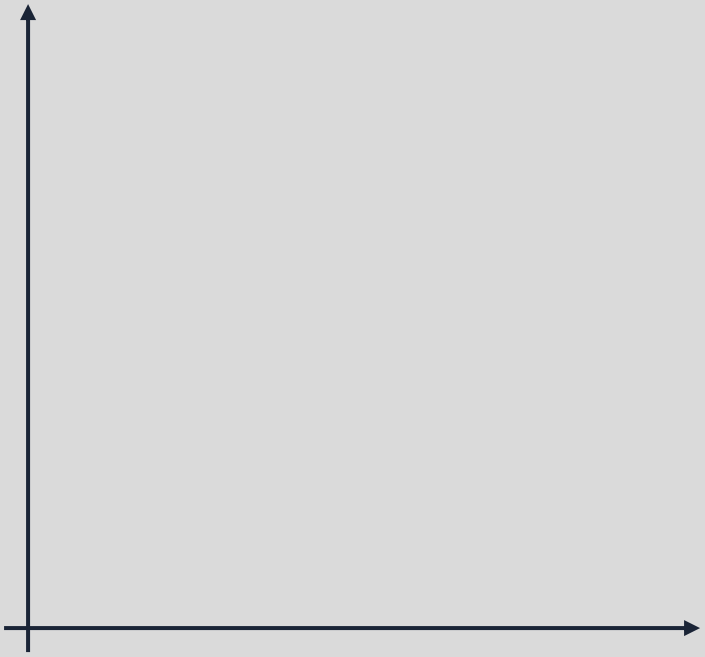
› Time frame

# (2) Price elasticity and total revenue

Different price elasticity affects seller's decision to either increase or reduce price as well due to effect to revenue.

Total revenue is defined by:





# (2) Price elasticity and total revenue

Mathematical proof.

# (3) Other elasticities of demand

We can also apply this concept to other types of demand.

## Definition 2.10

***Income elasticity of demand*** *is percentage change in quantity demanded for 1 percent of consumers' income increase.*

› $\varepsilon_I = \frac{\%change\ in\ quantity\ demanded}{\%change\ in\ consumer\ income} = \frac{\%\Delta Q_d}{\%\Delta I}$

We can measure both point and arc elasticity of demand respectively.

› Point : $\varepsilon_I = \frac{I}{Q} \cdot \frac{\Delta Q}{\Delta I} = \frac{I}{Q} \cdot \frac{Q_2 - Q_1}{I_2 - I_1}$

› Arc : $\varepsilon_I = \frac{I_2 + I_1}{Q_2 + Q_1} \cdot \frac{\Delta Q}{\Delta I} = \frac{I_2 + I_1}{Q_2 + Q_1} \cdot \frac{Q_2 - Q_1}{I_2 - I_1}$

# (3) Other elasticities of demand

We can also apply this concept to other types of demand.

**Definition 2.11**

***Cross-price elasticity of demand*** *is percentage change in quantity demanded for 1 percent of price increase of another commodity.*

› $\varepsilon_c = \frac{\%change\ in\ quantity\ demanded}{\%change\ in\ another\ commodity\ price} = \frac{\%\Delta Q_d^a}{\%\Delta P^b}$

We can measure both point and arc elasticity of demand respectively.

› Point : $\varepsilon_c = \frac{P^b}{Q} \cdot \frac{\Delta Q}{\Delta P^b} = \frac{P^b}{Q^a} \cdot \frac{Q_2^a - Q_1^a}{P_2^b - P_1^b}$

› Arc : $\varepsilon_c = \frac{P_2^b + P_1^b}{Q_2^a + Q_1^a} \cdot \frac{\Delta Q}{\Delta P^b} = \frac{P_2^b + P_1^b}{Q_2^a + Q_1^a} \cdot \frac{Q_2^a - Q_1^a}{P_2^b - P_1^b}$

# (4) Price elasticity of supply

## Definition 2.12

***Price elasticity of supply*** *is percentage change in quantity supplied for 1 percent of price increase.*

› $\varepsilon_S = \frac{\%change\ in\ quntity\ supplied}{\%change\ in\ price} = \frac{\%\Delta Q_S}{\%\Delta P}$

We can measure both point and arc elasticity of supply respectively.

› Point : $\varepsilon_S = \frac{P}{Q} \cdot \frac{\Delta Q}{\Delta P} = \frac{P}{Q} \cdot \frac{Q_2 - Q_1}{P_2 - P_1}$

› Arc : $\varepsilon_S = \frac{P_2 + P_1}{Q_2 + Q_1} \cdot \frac{\Delta Q}{\Delta P} = \frac{P_2 + P_1}{Q_2 + Q_1} \cdot \frac{Q_2 - Q_1}{P_2 - P_1}$

# (4) Price elasticity of supply

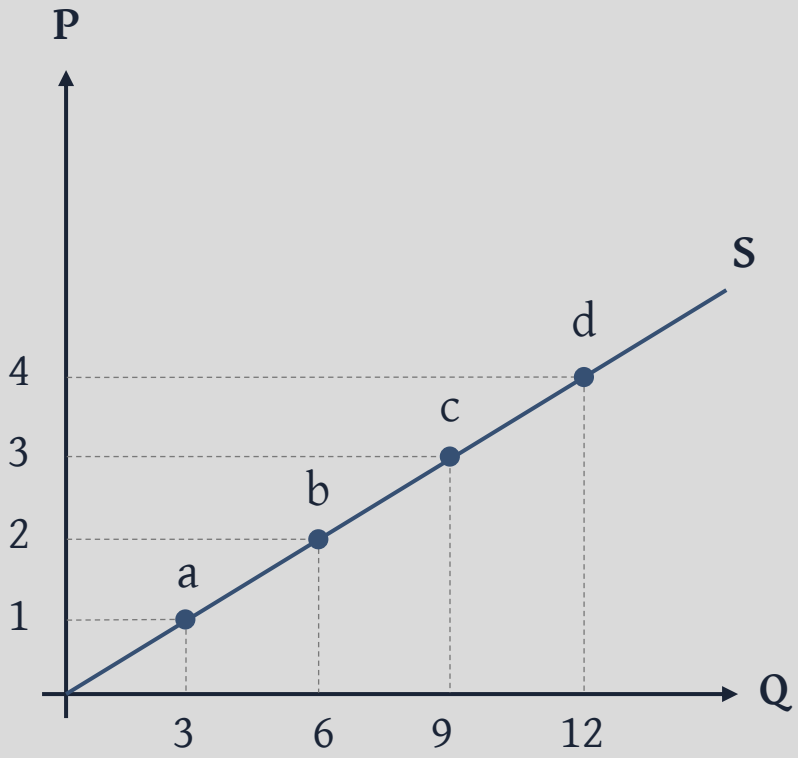



Figure out **point** elasticity on each coordinate.

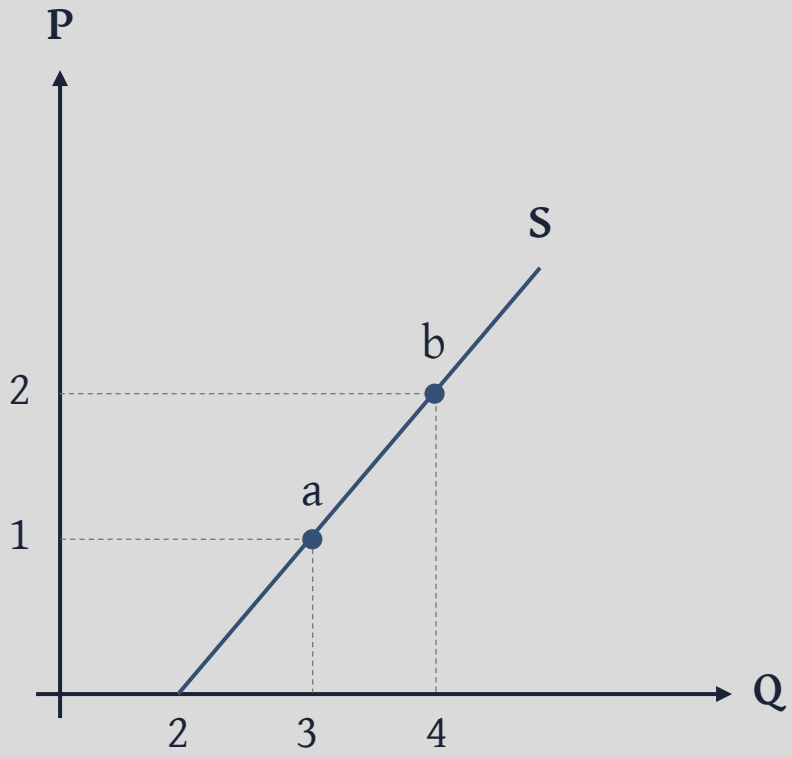
› $\varepsilon_{s(a)} =$

› $\varepsilon_{s(b)} =$

› $\varepsilon_{s(c)} =$

› $\varepsilon_{s(d)} =$

# (4) Price elasticity of supply




Given a supply equation as

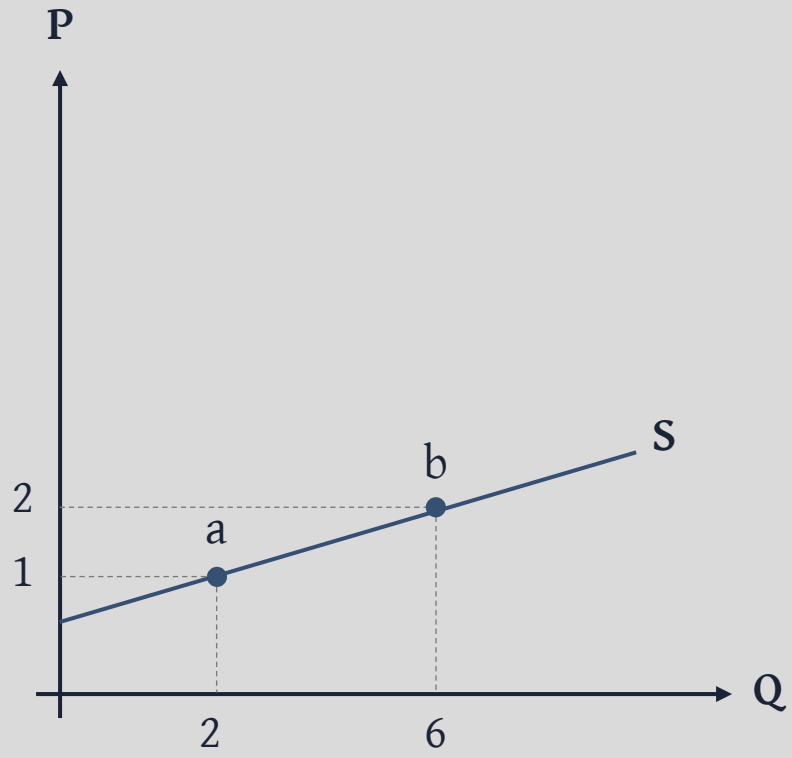
› $Q_s = P + 2$

Find point elasticity on these coordinates

› $\varepsilon_{s(a)} =$

› $\varepsilon_{s(b)} =$

# (4) Price elasticity of supply




Given a supply equation as

› $Q_s = 4P - 2$

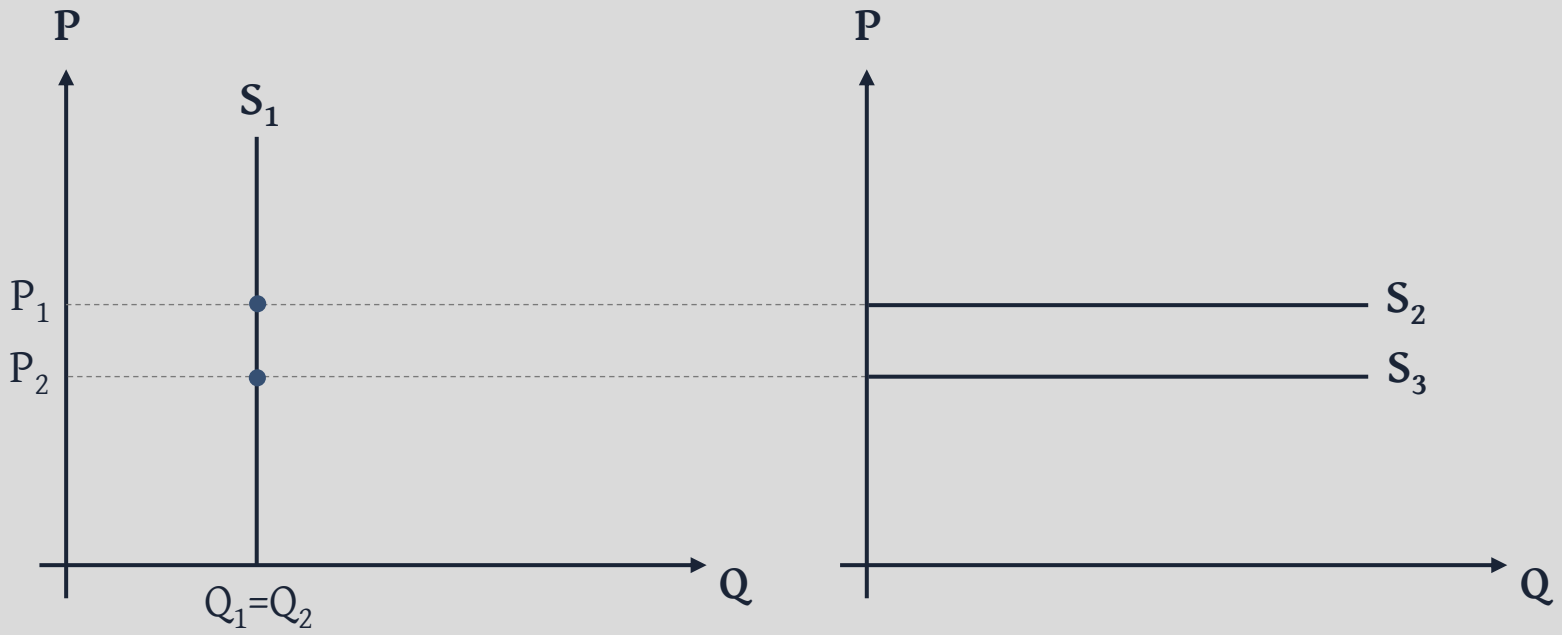
Find point elasticity on these coordinates

› $\varepsilon_{s(a)} =$

› $\varepsilon_{s(b)} =$

# (4) Price elasticity of supply

There are some supple lines that can be perfectly elastic or inelastic.



# (4) Price elasticity of supply

Price elasticity of supply depends on goods or services features.
Unlike demand, those characteristics are mostly related to production.
What direction of these determiners make supply more elastic?

› Cost of production

› Duration of production

› Time frame

# (1) Definition

As you may have seen that economists are obsessed with change in price, quantity and equilibrium. They would not matter if we are not able to interpret what comes after those events. Therefore, we need another concept to identify gains and losses for each party in a market.

Surplus is a concept that measures "social welfare" from trade in a market, which is also used to imply "market efficiency" compared to undesirable scenarios, such as government intervention or monopoly.

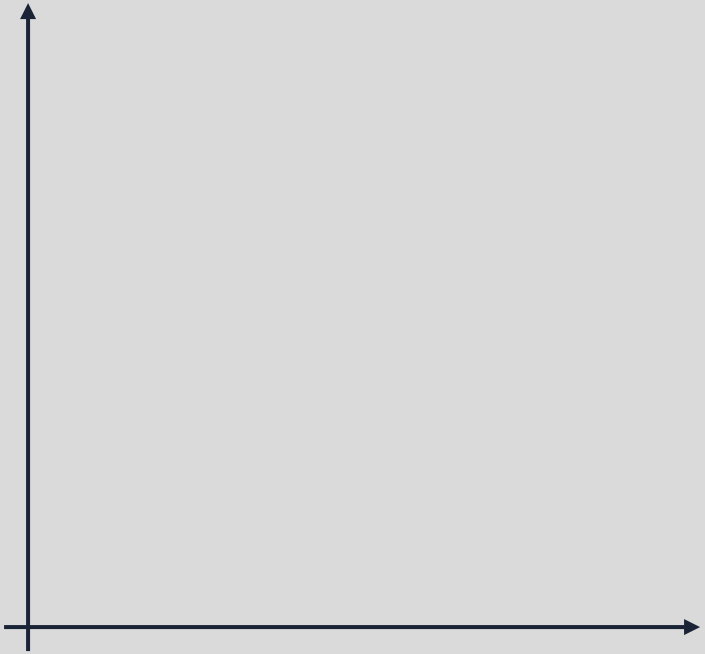
In a market, there are many groups of buyers and sellers. Buyers' preference and sellers' cost vary while market price is singular

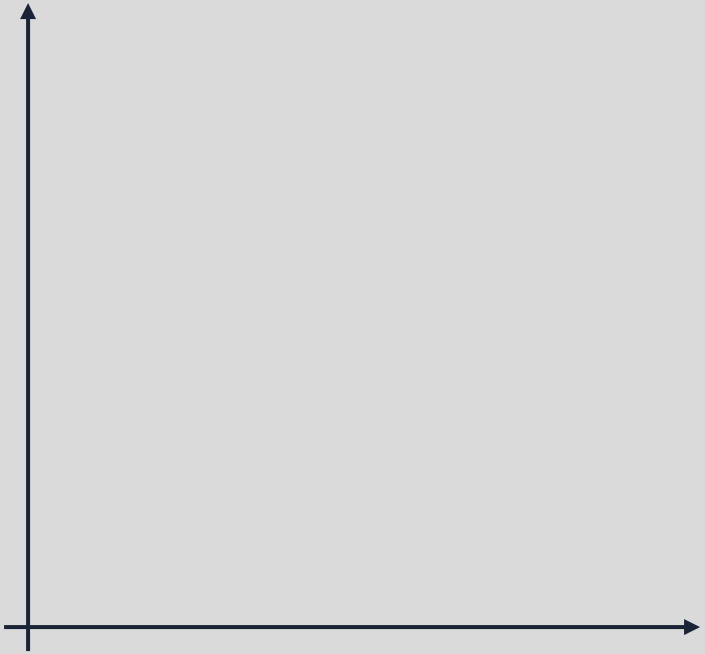
**Definition 2.13**

***Consumer surplus*** *is net gain or benefit of all consumers in a market, defined by difference between willingness to pay and market price.*

# (2) Consumer surplus

Firstly, we need to define what is  willingness to pay to understand surplus.

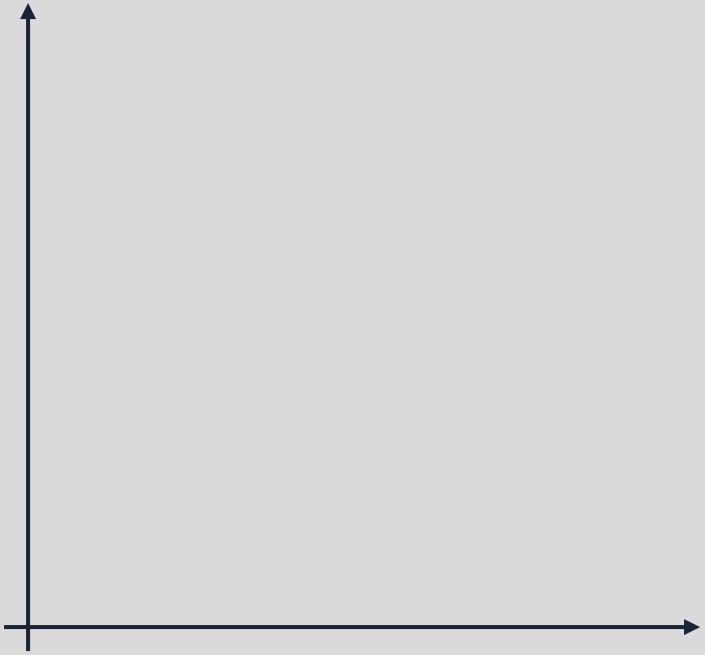


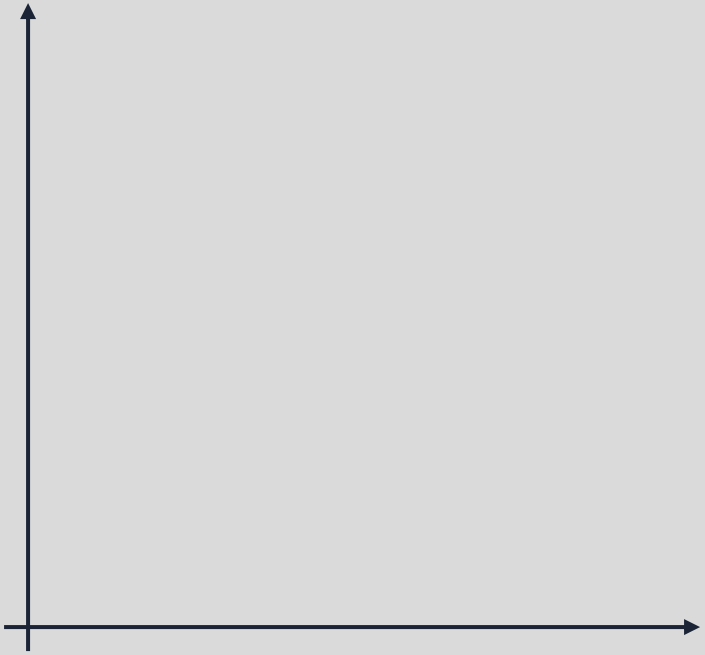


# (3) Producer surplus

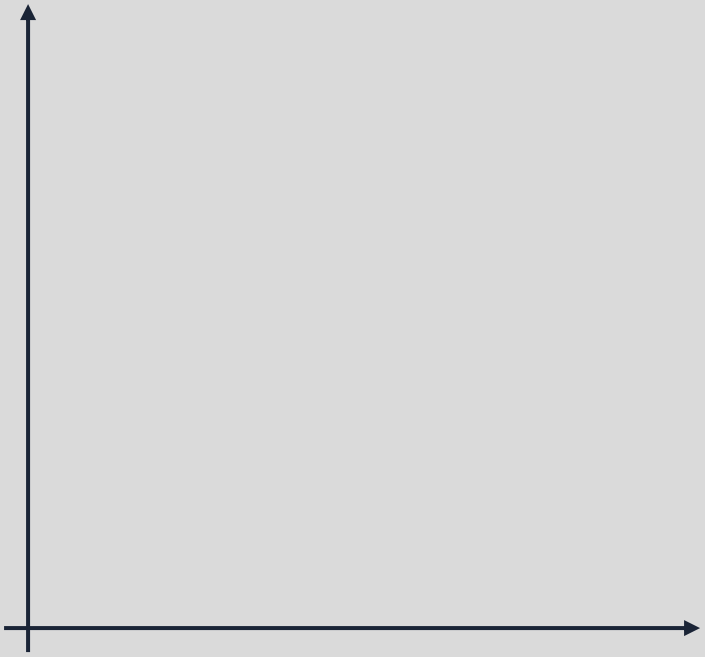
**Definition 2.14**

***Producer surplus*** *is net gain or benefit of all consumers in a market, defined by difference between market price and willingness to sell.*





# (4) Total surplus



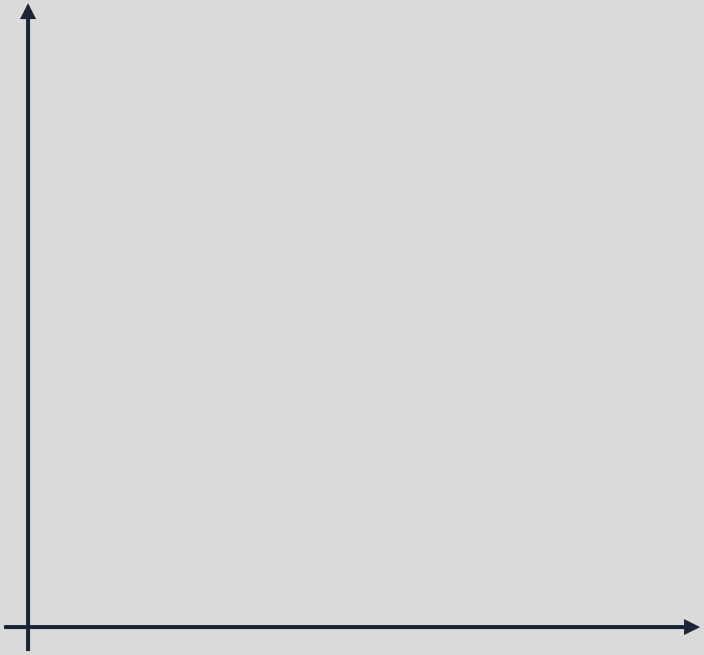
If the market is perfectly competitive, total surplus is sometimes referred as “social welfare”.

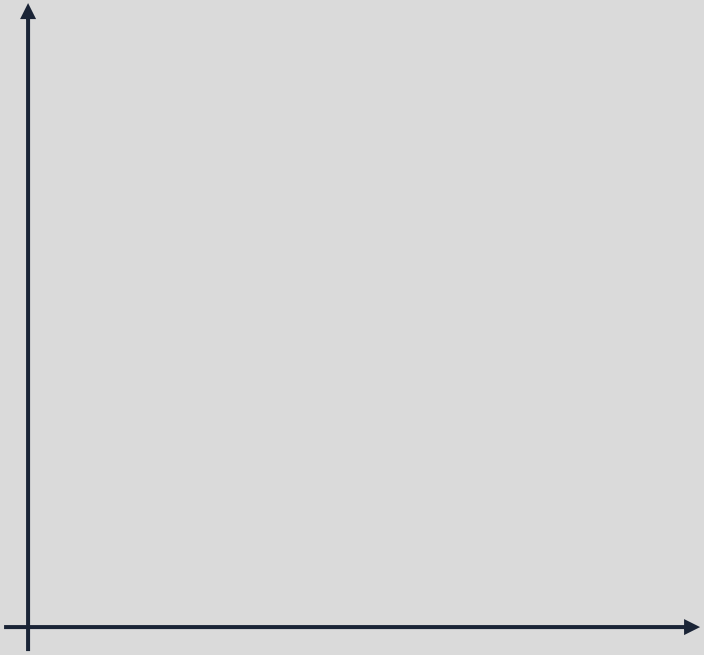
This concept is used throughout the analyses when price, quantity or equilibrium shifts.

Note that this “welfare” only means welfare gained from trade.

# (5) Price change and surplus

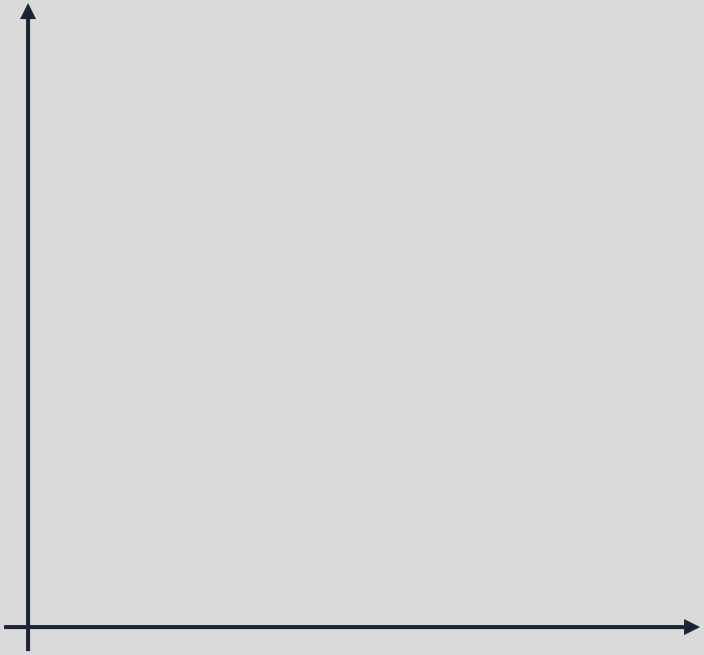
Let’s consider surplus change for each party from these cases when demand surge and supply drops.

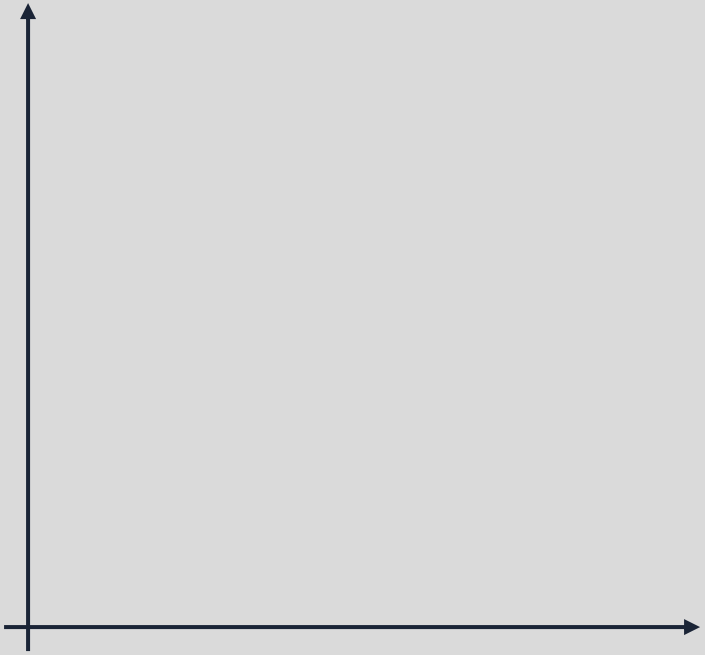




# (5) Price change and surplus

Price elasticity also affects surplus for each party as well. See the cases below when demand is inelastic and supply is elastic.





# (1) Problem statement

No such country relies solely on market for resource allocation. A central institution, most of the time is called “government”, or economic and political institutions are founded to intervene markets for many circumstances such as

› when market fails

› trying to stabilize price for essential commodities

› maintaining political and economic stability

› building infrastructures and public goods

There are many tools to intervene market such as price settings, government purchasing, taxing which we will analyze the consequences using surplus framework. The first one here is price setting.

# (2) Price setting

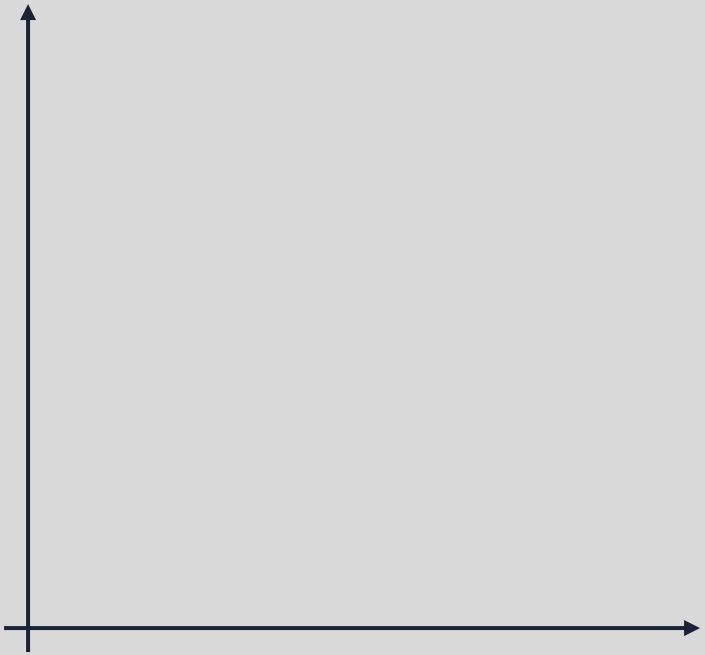
Price setting schemes can be broadly categorized as setting (1) ceiling price and (2) floor price, defined as follows.

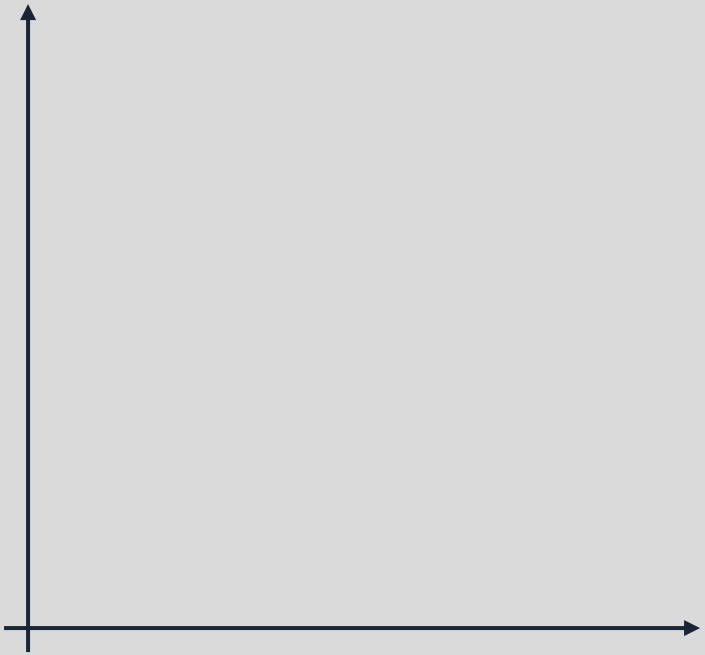
**Definition 2.15**

***Ceiling Price*** *is set for any commodity not to be traded above set price. Such price is mostly set via legal channel or issued as a specialized policy.*

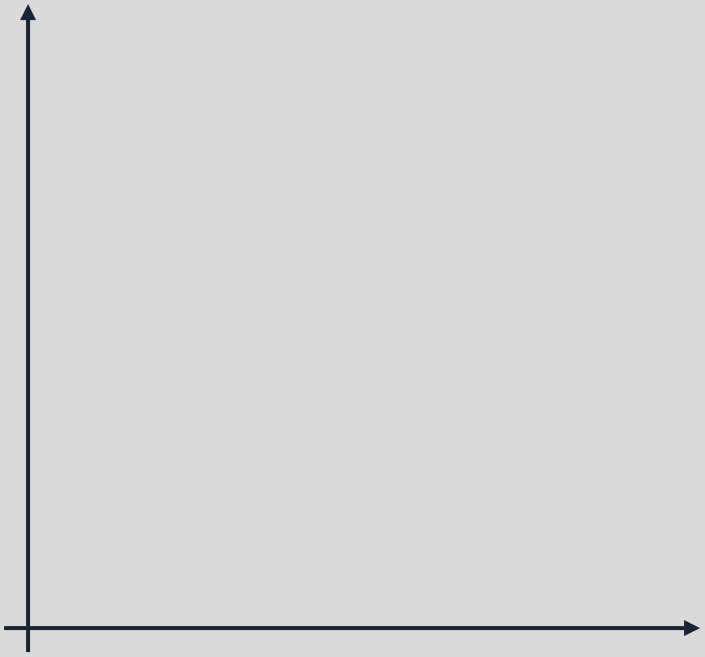
# (2) Price setting

Ceiling price can be set both above and below the market price.





# (2) Price setting



Now let's analyze effects on surplus when it is binding.

› It causes excess _____ .

› How does it affect equilibrium price and quantity?

› How does it alter total welfare?

| Surplus | Before | After | Diff. |
|---|---|---|---|
| CS | | | |
| PS | | | |
| Total | | | |

## (2) Price setting

As you can see, there is a part of surplus which is lost after the intervention, this part is called “deadweight loss”.

**Definition 2.16**

***Deadweight loss**, also known as excess burden or allocative inefficiency, is a loss of economic efficiency that can occur when the free market equilibrium for a good or a service is not achieved.*

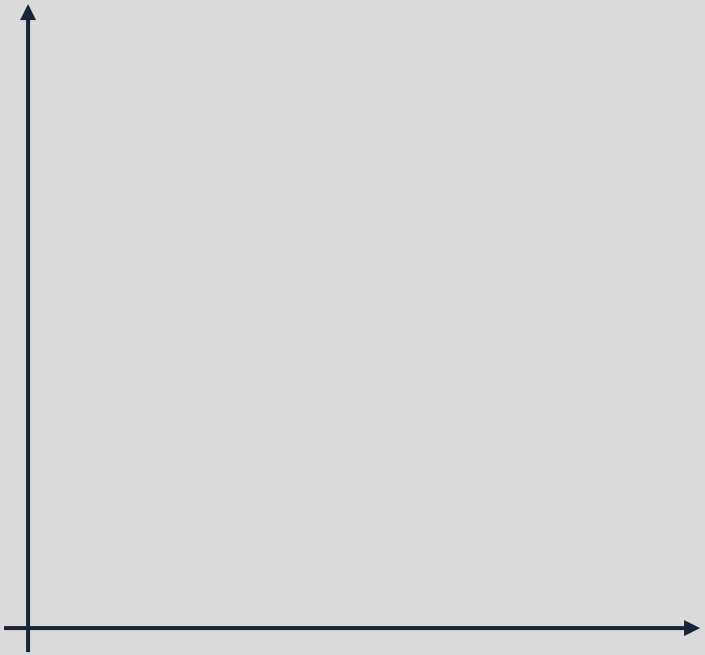
Next up, floor price can also be set for another purpose.

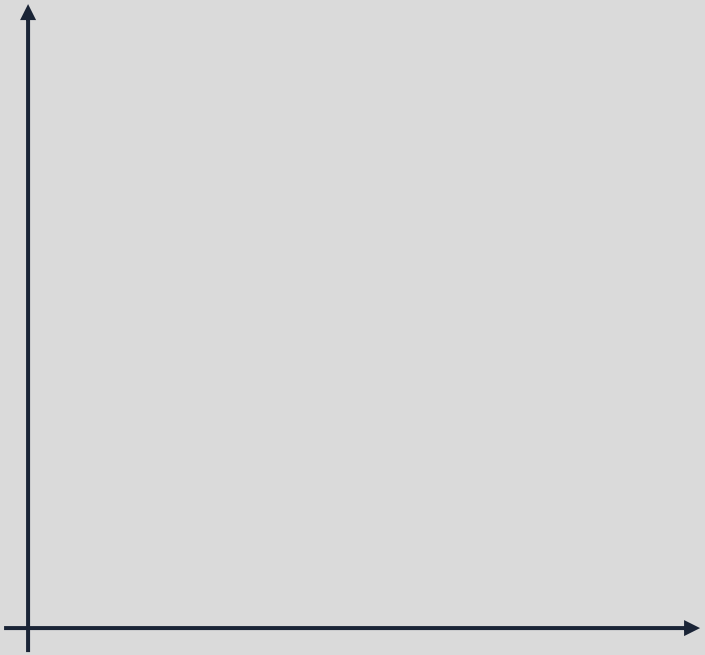
**Definition 2.17**

***Floor price** is set for any commodity not to be traded below set price. Such price is mostly set via legal channel or issued as a specialized policy.*

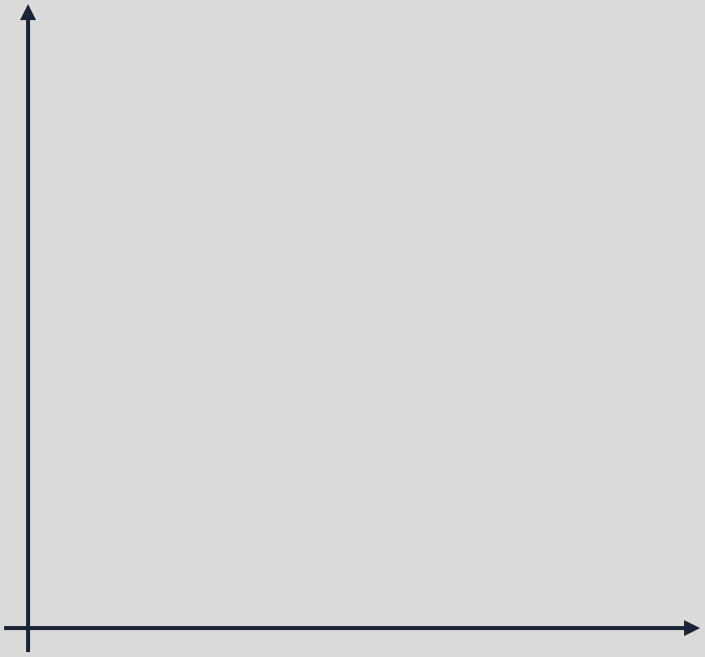
# (2) Price setting

Floor price can be set both above and below the market price.





# (2) Price setting



Now let's analyze effects on surplus when it is binding.

› It causes excess _____ .

› How does it affect equilibrium price and quantity?

› How does it alter total welfare?

| Surplus | Before | After | Diff. |
|---|---|---|---|
| CS | _____ | _____ | _____ |
| PS | _____ | _____ | _____ |
| Total | _____ | _____ | _____ |

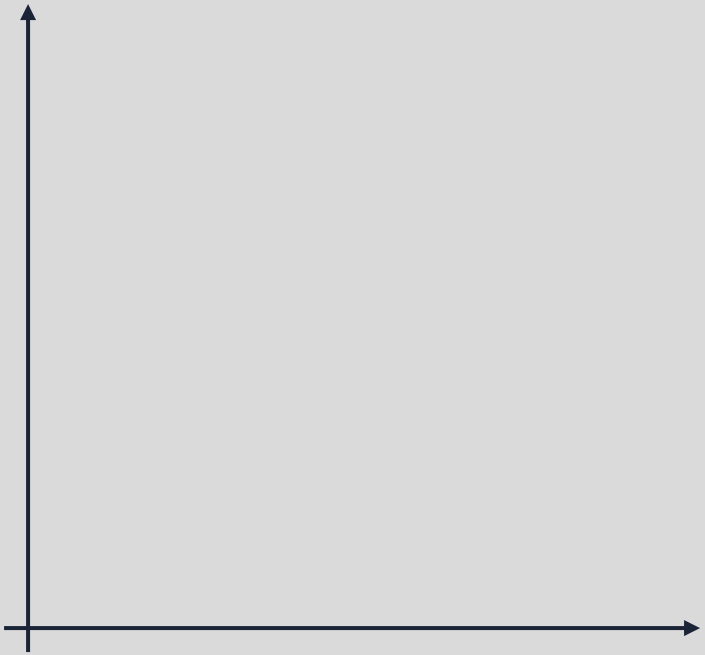
# (3) Price support

Price support is very similar to floor price, instead, it can be coupled with other measures for better solution.

**Definition 2.18**

***Price support*** *is either a subsidy, price control or setting a production quota, with the intention to keep market price of a commodity higher than the competitive level.*

# (3) Price support



The first one is called **"government purchasing program"** which assumptions are imposed as follows.

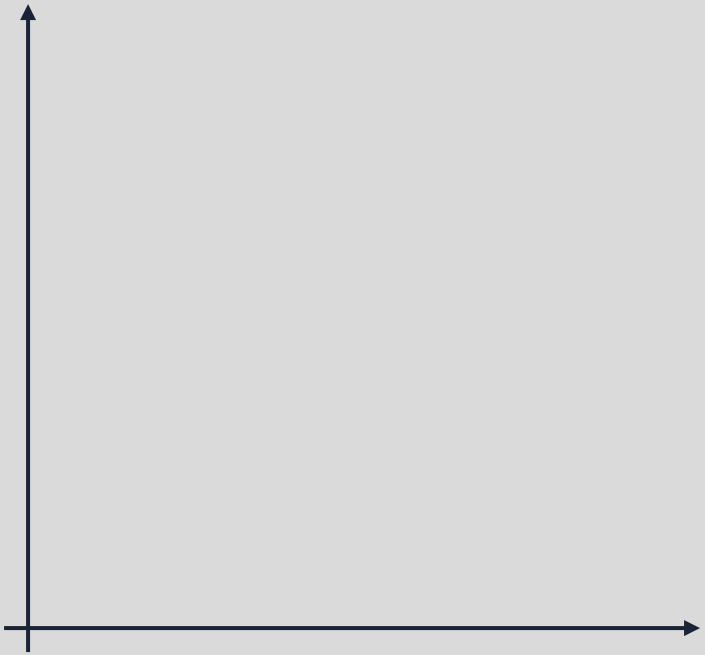
› The government set floor price above market price, raising price upward.

› There is some excess supply in the market since producer see this opportunity.

› The government buys out all the excess supply.

| Surplus | Before | After | Diff. |
|---|---|---|---|
| CS | | | |
| PS | | | |
| Gov. revenue | | | |
| Total | | | |

# (3) Price support



The second one is called **"acreage limitation program"** or "production quota" which assumptions are imposed as follows.

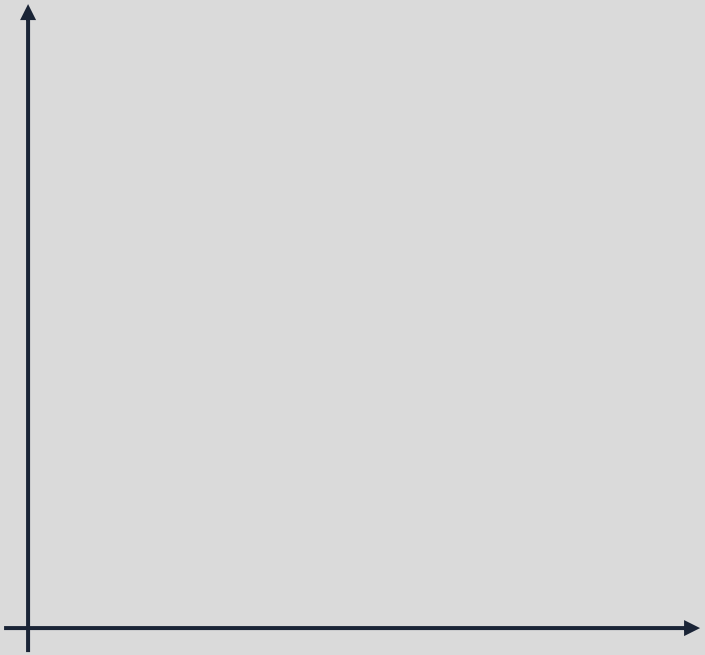
› The government chooses a limited quantity supplied, corresponding to the price level they want to raise.

› At this price, producers are signaled to produce more.

› The government pays the producers as if they can sell at that price to compensate lost surplus.

| Surplus | Before | After | Diff. |
|---|---|---|---|
| CS | | | |
| PS | | | |
| Gov. revenue | | | |
| Total | | | |

# (3) Price support



The third one is called **"deficiency payment"** which assumptions are imposed as follows.

› The government signal targeted price above market level.

› At this price, producers are signaled to produce more, leading to excess supply.

› Let the exchange be as the price set. Excess supply would eventually cause price drop.

› The government pays for deficiency to the producers as their compensation.

| Surplus | Before | After | Diff. |
|---|---|---|---|
| CS | | | |
| PS | | | |
| Gov. revenue | | | |
| Total | | | |

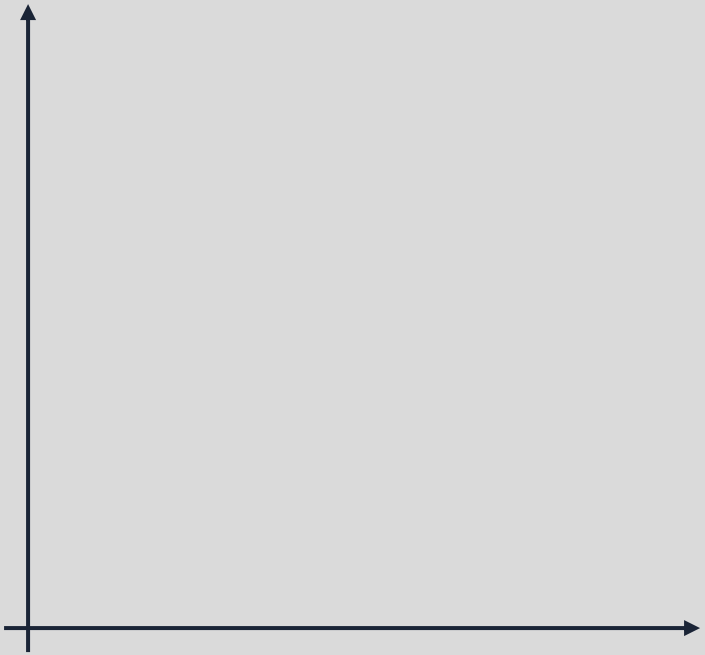
# (4) Tax and subsidy

**Definition 2.19**

***Taxation*** *can be fundamentally divided into unit tax, which is collected equally on each unit sold in a market, and ad valorem tax, which its amount collected based on value of transaction in a market such as sales tax or value added tax. Taxing would discourage the party taxed but subsidy works another way around.*

Since subsidy will affect market in an opposite way, this class will cover only taxation.

# (4) Tax and subsidy

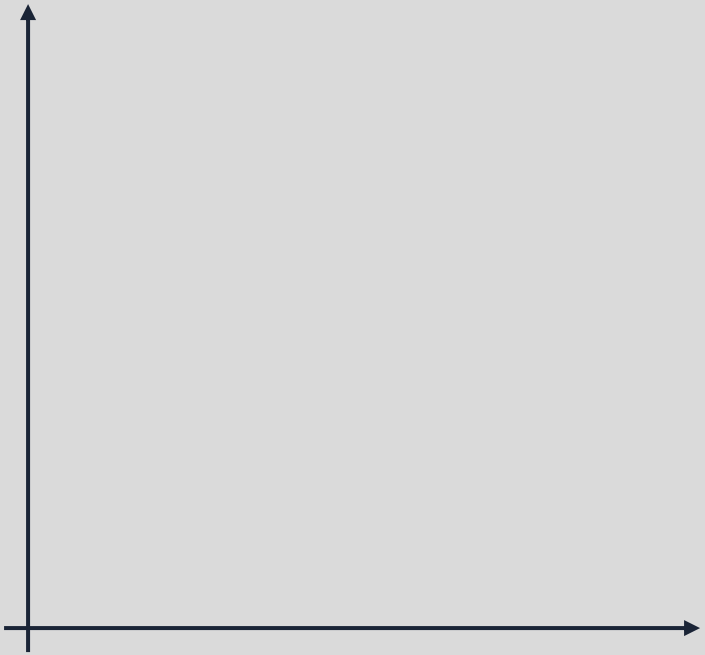


Introducing tax burden, each party would bear different level of tax burden in different scenarios.

We first look at the case when tax is **imposed on seller**.

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |

# (4) Tax and subsidy

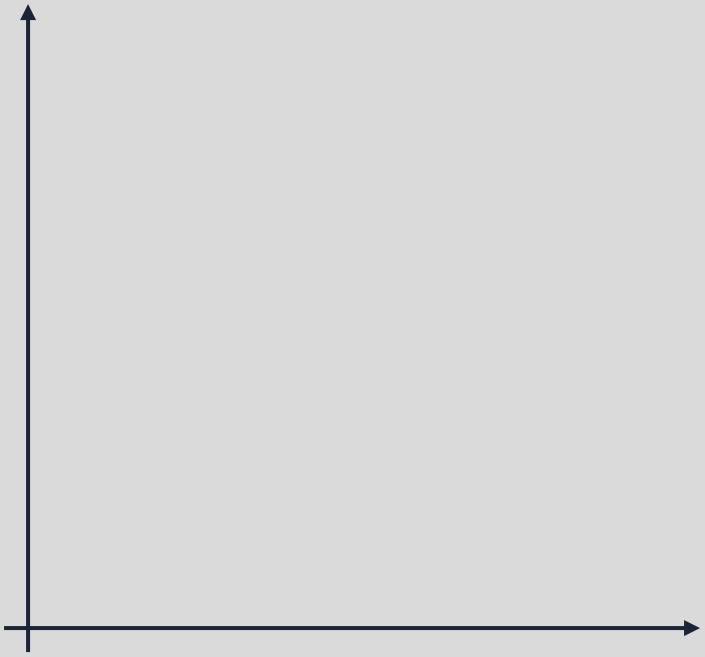


Let's see how different elasticity play which role in tax burden.

We turn to the case when tax is **imposed on seller** and the demand is **quite inelastic.**

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |

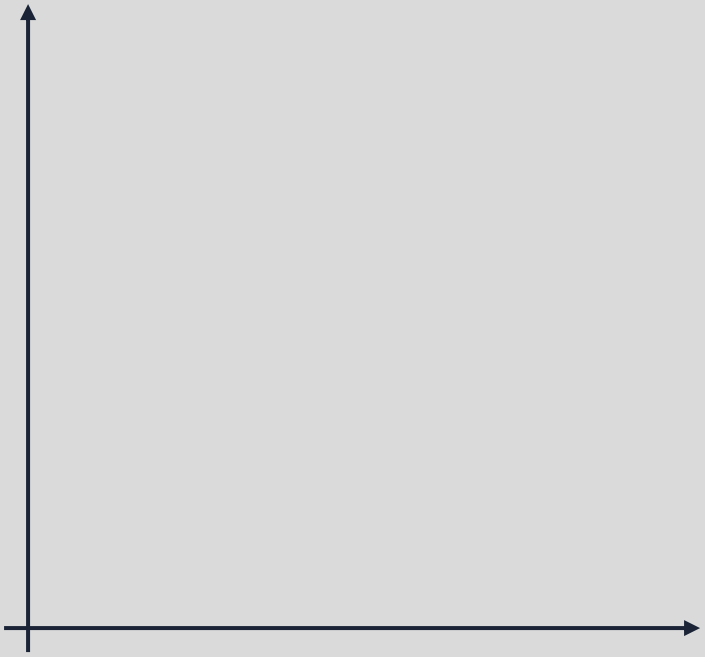
# (4) Tax and subsidy



Now consider tax **imposed on seller** and the demand is **perfectly inelastic.**

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |

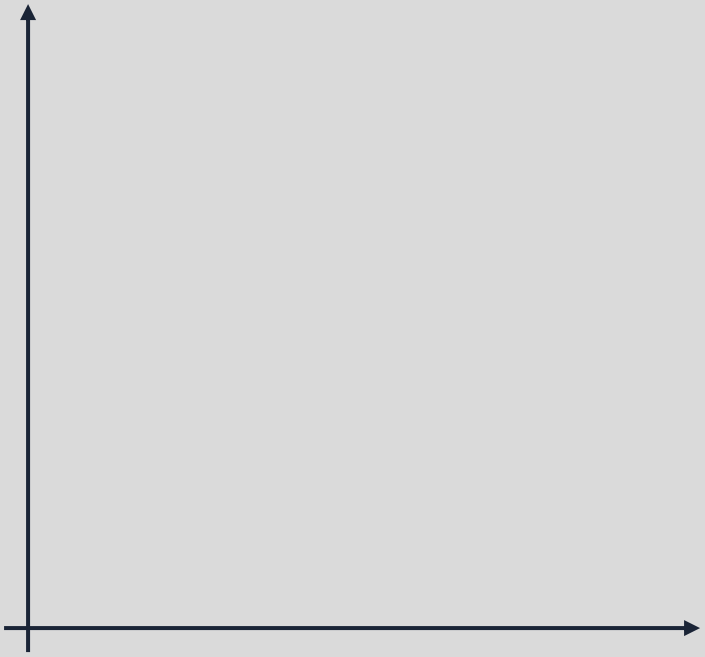
# (4) Tax and subsidy



On the other hand, what happens when tax is **imposed on consumer**.

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |

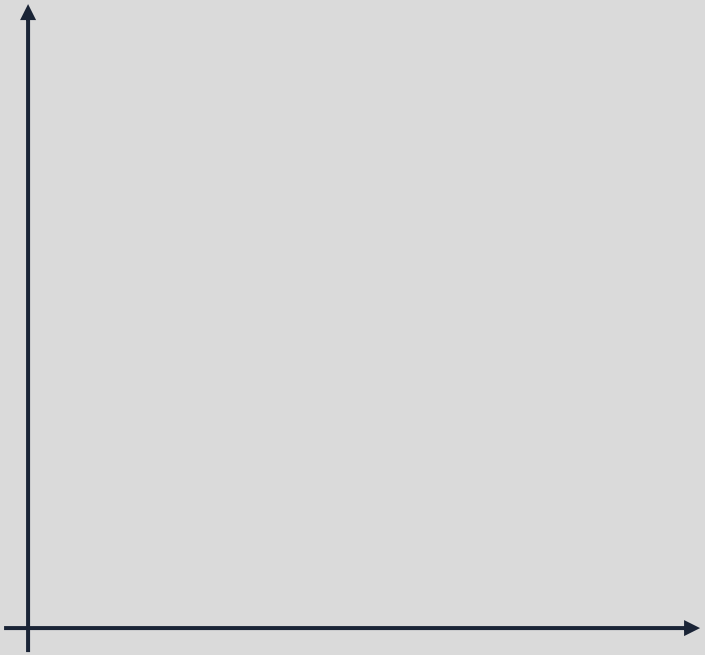
# (4) Tax and subsidy



We turn to the case when tax is **imposed on consumer** and the supply is **quite elastic.**

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |

# (4) Tax and subsidy



Now consider tax **imposed on consumer** and the supply is **perfectly inelastic.**

| Surplus | Before | After | Diff. | Tax burden |
|---|---|---|---|---|
| CS | | | | |
| PS | | | | |
| Gov. revenue | | | | |
| Total | | | | |