Chapter 8 Price Elasticity of Supply

Price Elasticity of Supply is the percentage change of the quantity supplied per 1 percentage change in price

$$\eta_S = \frac{\%\Delta Q_S}{\%\Delta P} = \frac{Percentage\ change\ of\ Q_S}{Percentage\ change\ of\ P}$$

- η_S measures how sensitive the supply is to a change in price.

Example If the price increases by 10% ($\%\Delta P = 10\%$), the quantity supplied increases by 25% ($\%\Delta Q_D = -25\%$)

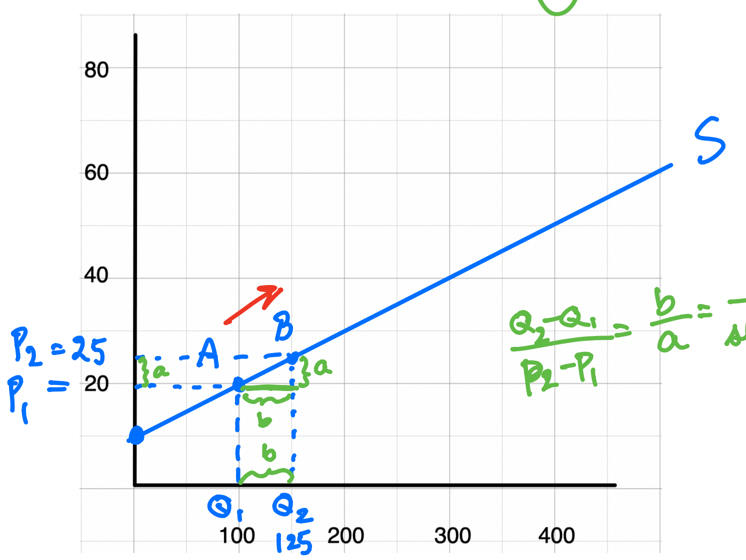
$$\eta_S = \frac{\%\Delta Q_S}{\%\Delta P} = \frac{25}{10} = 2.5$$

- Positive sign reflects the Law of Supply
- η_S does not have unit
- $\eta_D = 2.5$ means that if the price increases by 1%, the quantity supplied increases by 2.5%

Example

$$Supply: \ P = 10 + \frac{1}{10} Q_S$$

slope



$\frac{Q_2 - Q_1}{P_2 - P_1} = \frac{b}{a} = \frac{1}{\text{slope of } S}.$

Consider two points, A and B on the supply

$$A = (100,20), Q_1 = 100, P_1 = 20$$
$$B = (150,25), Q_2 = 150, P_2 = 25$$

From $A \rightarrow B$,

$$\Delta Q_S = Q_2 - Q_1 = 150 - 100 = 50$$
$$\Delta P = P_2 - P_1 = 25 - 20 = 5.$$

$$\%\Delta Q_S = \frac{50}{100} = 50\% = \frac{Q_2 - Q_1}{Q_1}$$
$$\%\Delta P = \frac{5}{20} = 25\% = \frac{P_2 - P_1}{P_1}$$

$$\eta_S = \frac{\%\Delta Q_S}{\%\Delta P} = \frac{50\%}{25\%} = 2.$$

$$= \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1} = \left(\frac{\overbrace{Q_2 - Q_1}^{b}}{\underbrace{P_2 - P_1}_{a}}\right) \cdot \frac{P_1}{Q_1}$$

$$= \frac{1}{\text{slope of } S} \cdot \frac{P_1}{Q_1} = \frac{1}{1/10} \cdot \frac{20}{100} = 2.$$

- η_S from A to B is given by:

$$\eta_S = \frac{1}{\underset{\text{of } S}{Slope}} \frac{P_1}{Q_1}$$

where P_1 and Q_1 are price and quantity supplied at A.

- Is η_S the same for $\overset{\text{new}}{B} \rightarrow \overset{\text{old}}{A}$?

$$\eta_S = \frac{\%\Delta Q_S}{\%\Delta P} = \underbrace{\frac{Q_1 - Q_2}{P_1 - P_2}}_{\frac{1}{\text{slope of } S}} \frac{P_2}{Q_2}.$$

- η_S from $B \rightarrow A$ is given by:

$$\eta_S = \frac{1}{Slope} \frac{P_2}{Q_2} = \frac{1}{1/10} \cdot \frac{25}{150} = \frac{5}{3}.$$

where P_2 and Q_2 are price and quantity supplied at B.

Arc Elasticity of Supply

From $A \rightarrow B$, $\eta_S = \frac{1}{Slope} \frac{P_1}{Q_1} = 2.$

From $B \rightarrow A$, $\eta_S = \frac{1}{Slope} \frac{P_2}{Q_2} = 1.67$

midpoint $\eta_S = 1.8.$

If we want to find, η_S between A and B (without specifying from where to where) we use

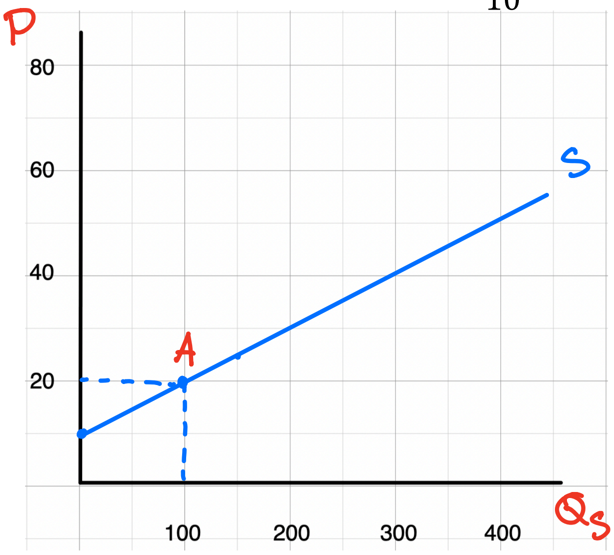
Average Price $= \bar{P} = \frac{P_1+P_2}{2}$

Average Quantity $= \bar{Q} = \frac{Q_1+Q_2}{2}$

$$\eta_S = \frac{1}{Slope}\frac{\bar{P}}{\bar{Q}} = \frac{1}{Slope}\frac{\bar{P}}{\bar{Q}} = \frac{1}{Slope}\frac{(P_1+P_2)\cancel{/2}}{(Q_1+Q_2)\cancel{/2}}$$

$$= \frac{1}{1/10}\cdot\frac{22.5}{125} = \frac{9}{5} = 1.8.$$

$$Supply:\ P = 10 + \frac{1}{10}Q_S \qquad \frac{1}{1/10}\cdot\frac{45}{250} = 1.8.$$



This is called ***Arc Elasticity by Midpoint method***.

Supply $P = 10 + \frac{1}{10}Q_S$

$Q_S = -100 + 10P$

Point Elasticity of Supply at a point $A = (Q_1, P_1) = (100,20)$.

$$\frac{dQ_S}{dP} = 10$$

$$\eta_S = \left(\frac{1}{Slope\ at\ A}\right)\frac{P_1}{Q_1}$$

$$= \frac{1}{\frac{dP}{dQ_S}}\frac{P_1}{Q_1}$$

$$= \frac{dQ_S}{dP}\frac{P_1}{Q_1} = 10\left(\frac{20}{100}\right) = 2$$

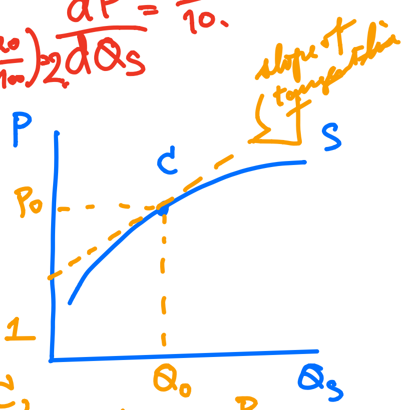
$$\frac{dP}{dQ_S} = \frac{1}{10}.$$

Elastic and Inelastic Supply

Supply is Elastic when $\eta_S > 1$

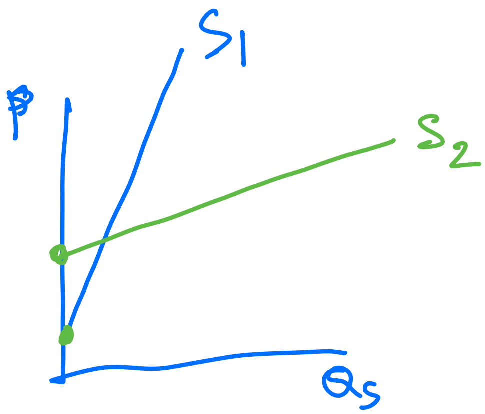
Supply is Inelastic when $\eta_S < 1$.

Supply has unit elasticity if $\eta_S = 1$



At C,

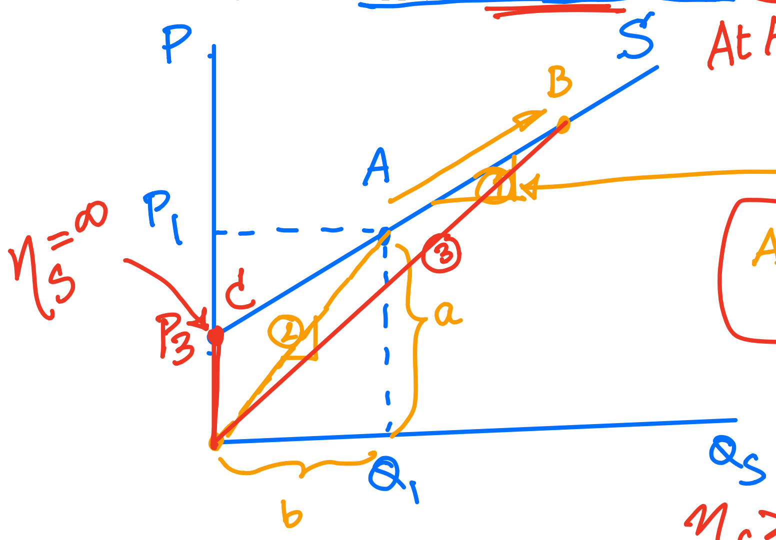
$$\eta_S = \frac{1}{(\text{slope of tangent line})}\cdot\frac{P_0}{Q_0}.$$



Point Elasticity of along a Linear Supply Curve

$\eta_S > 1$ always. always elastic.

1. η_S when Supply has positive intercept.



At A. $\eta_S = \frac{1}{\text{slope at } A} \cdot \frac{P_1}{Q_1} = \frac{2}{1} > 1.$

At B $= \frac{3}{1} > 1$

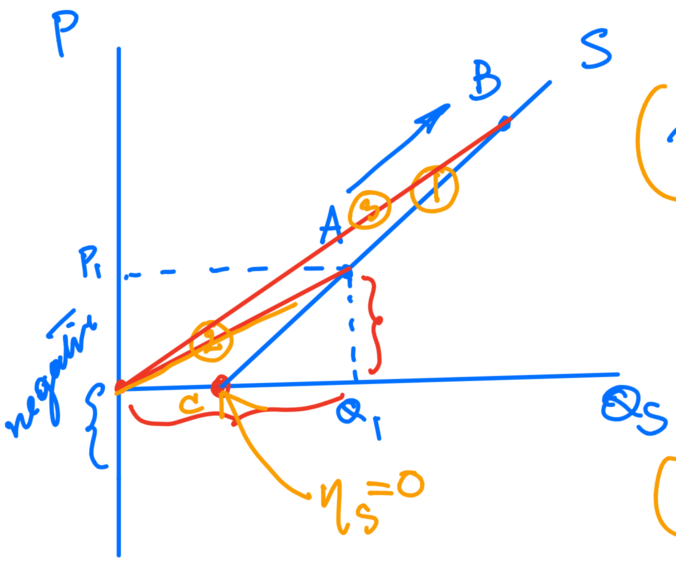
$(\eta_S)_A > (\eta_S)_B.$

$\eta_S > 1$ and keeps decreasing as we move up the S curve

At C, $Q_S = 0$, Price $= P_3$

$\eta_S = \frac{1}{(\text{slope S at C})} \cdot \frac{P_3}{0} = \infty$

2. η_S when Supply has negative intercept.



$(\eta_S)_A = \frac{1}{(\text{slope at } A)} \cdot \frac{P_1}{Q_1} = \frac{2}{1} < 1.$

η_S is always < 1 inelastic

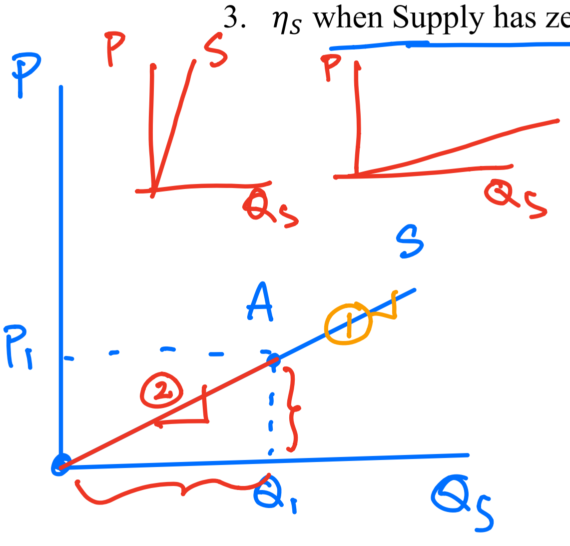
$(\eta_S)_B = \frac{3}{1} < 1$

and η_S keeps increasing as we move up the S curve.

At C, Price $= 0$, $Q_S = Q_0 > 0$

$(\eta_S)_C = \frac{1}{(\text{slope of S at C})} \cdot \frac{0}{Q_0} = 0$

3. η_S when Supply has zero intercept.



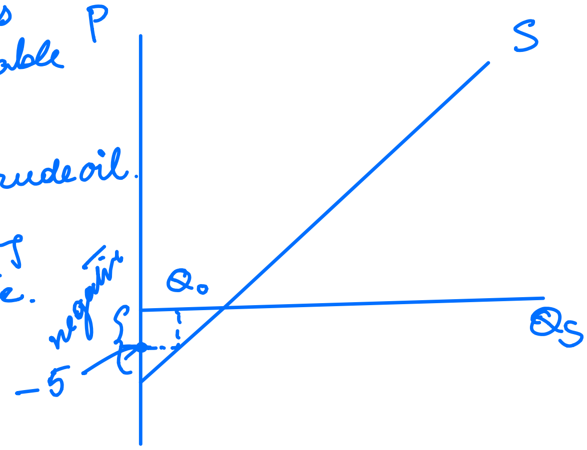
$\eta_S = \frac{1}{\text{slope at } A} \cdot \frac{P_1}{Q_1} = \frac{2}{1} = 1$

always $\eta_S = 1$.

2 possible interpretations of S with neg intercept

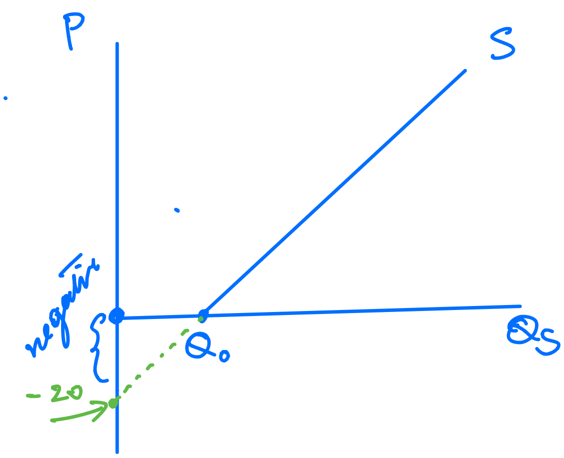
① price = −5 \$ sellers still are willing and able to sell Q_0

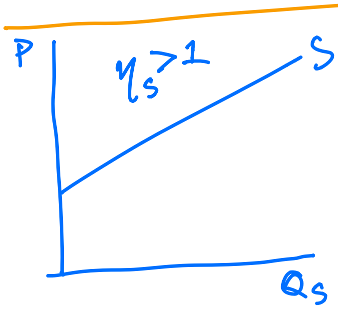
– Example price of crude oil was negative during COVID-19 pandemic.

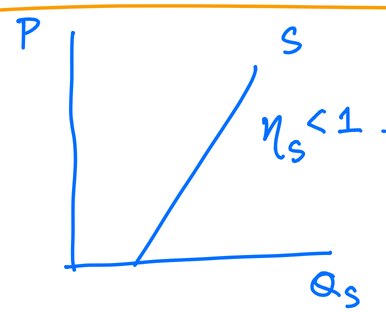


② At price = 0, $Q_S = Q_0$ but at price < 0, $Q_S = 0$.

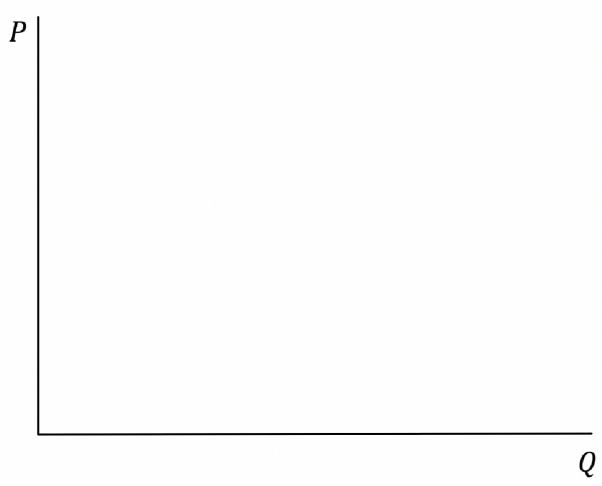
Supply $P = -20 + \frac{1}{10} Q_S$.







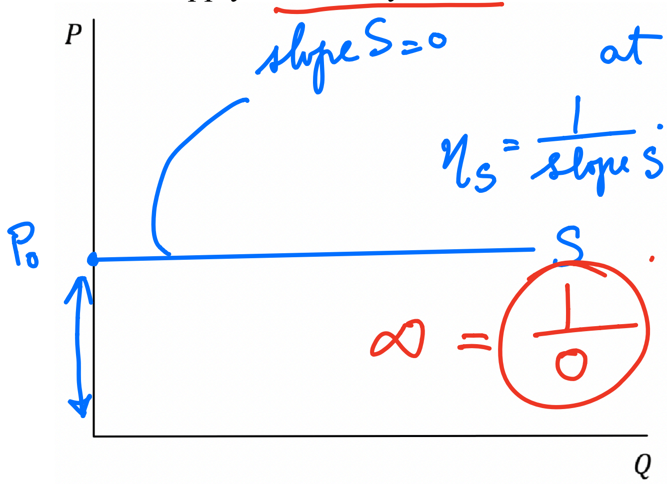
Point Elasticity of a Nonlinear Supply curve



Extreme Cases

$\eta_s = \infty$

1. Supply is Perfectly Elastic – S is horizonal.



at P_0, Q_s is ∞ – as much as what is demanded by the market will be produce.

$\eta_s = \frac{1}{\text{slope } S} \cdot \frac{P_0}{Q_0} = \infty$

but at price $< P_0$ $Q_s = 0$

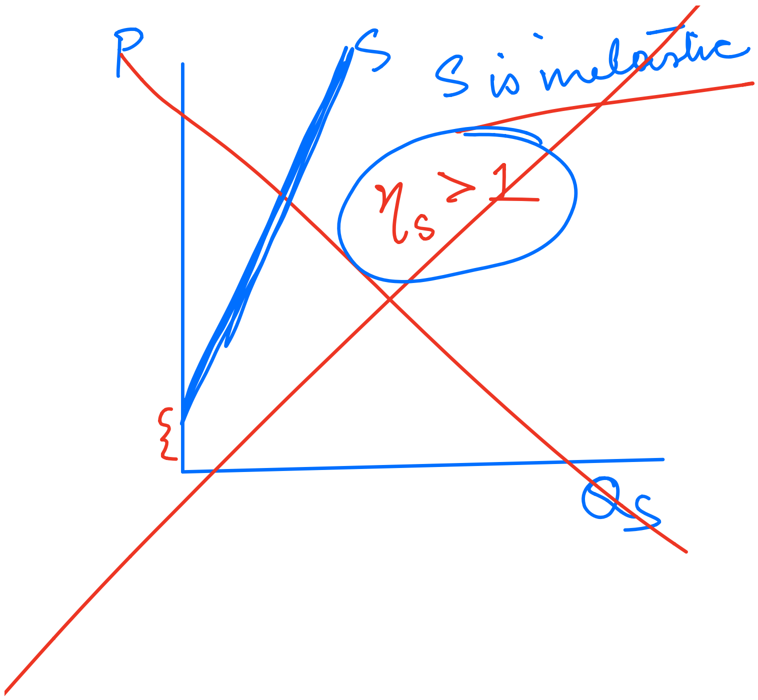
2. Supply is Perfectly Inelastic $= \eta_s = 0$

$\eta_s = \frac{1}{\text{slope of } S} \cdot \frac{P_0}{Q_0}$

$= 0$

At price $\geq P_0$, $Q_s = Q_0$

but at price $< P$, $Q_s = 0$.


P
S
S is inelastic
$\eta_s > 1$
Q_s