Plan for the Lecture

- Concept of elasticity of supply and demand

- Examine the effect of another government intervention in the market (a tax).

I. ELASTICITY

Price Elasticity of Demand (ε_D)

$$\varepsilon_D = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

(In absolute value)

Elastic $\varepsilon_D > 1$

Inelastic $\varepsilon_D < 1$

Perfectly inelastic $\varepsilon_D = 0$

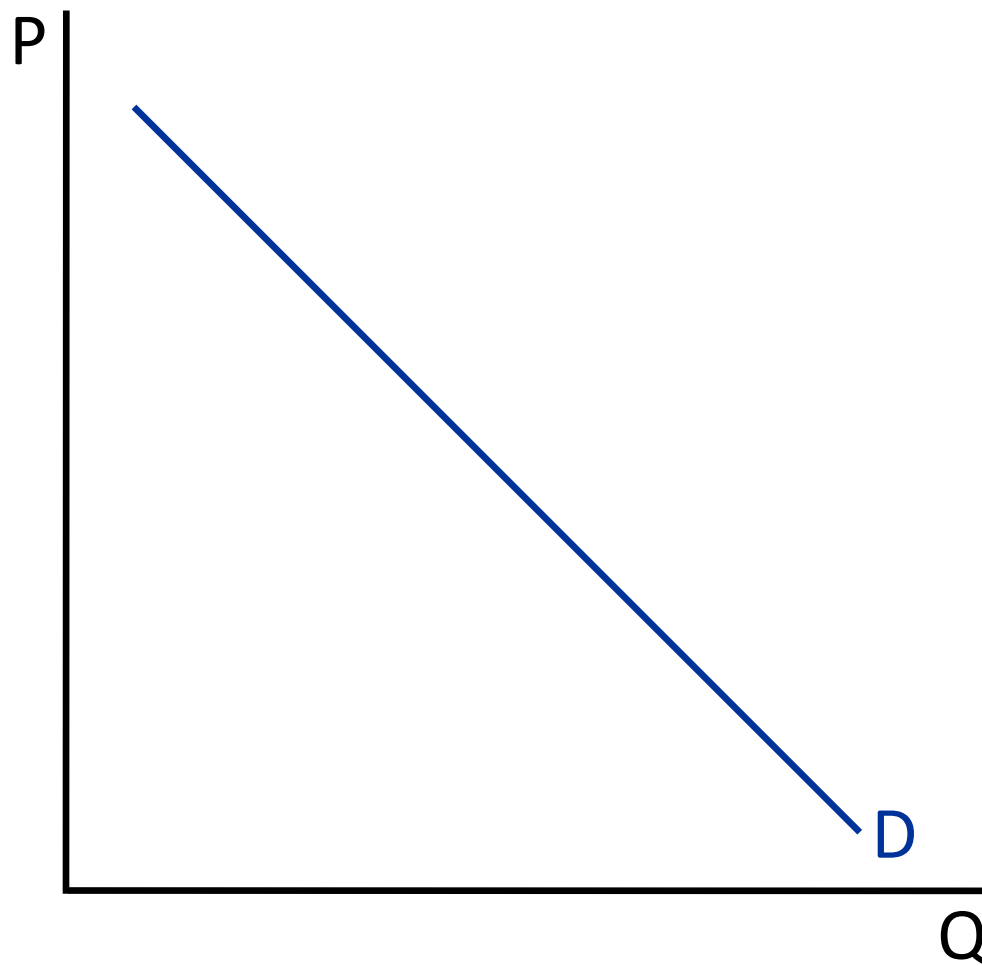Perfectly elastic $\varepsilon_D = \infty$

Relationship between Demand Elasticity and the Slope of the Demand Curve

$$\varepsilon_D = \frac{\Delta Q_D / Q_D}{\Delta P / P}$$

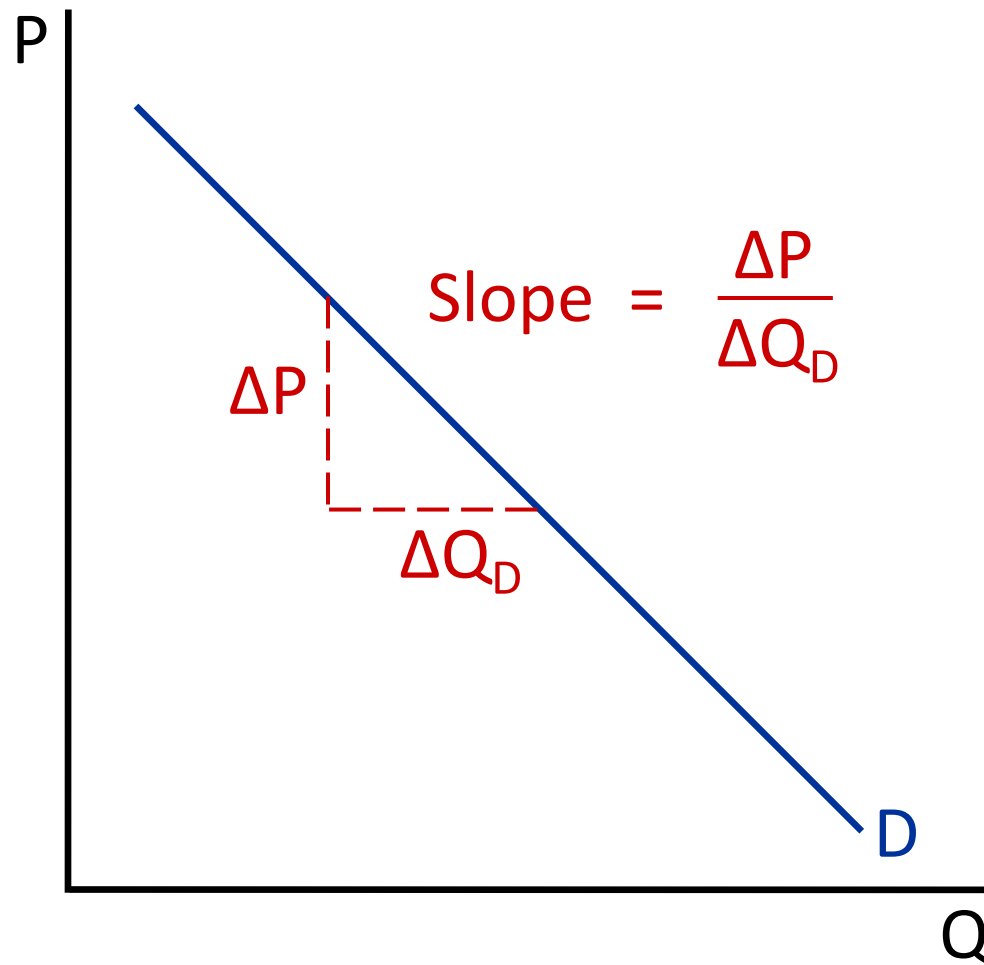$$= \frac{\Delta Q_D}{\Delta P} \cdot \frac{P}{Q_D}$$

Interpretation: if price changes by 1%, then demand changes by ε_D %.

Economists like elasticities because they are unit free
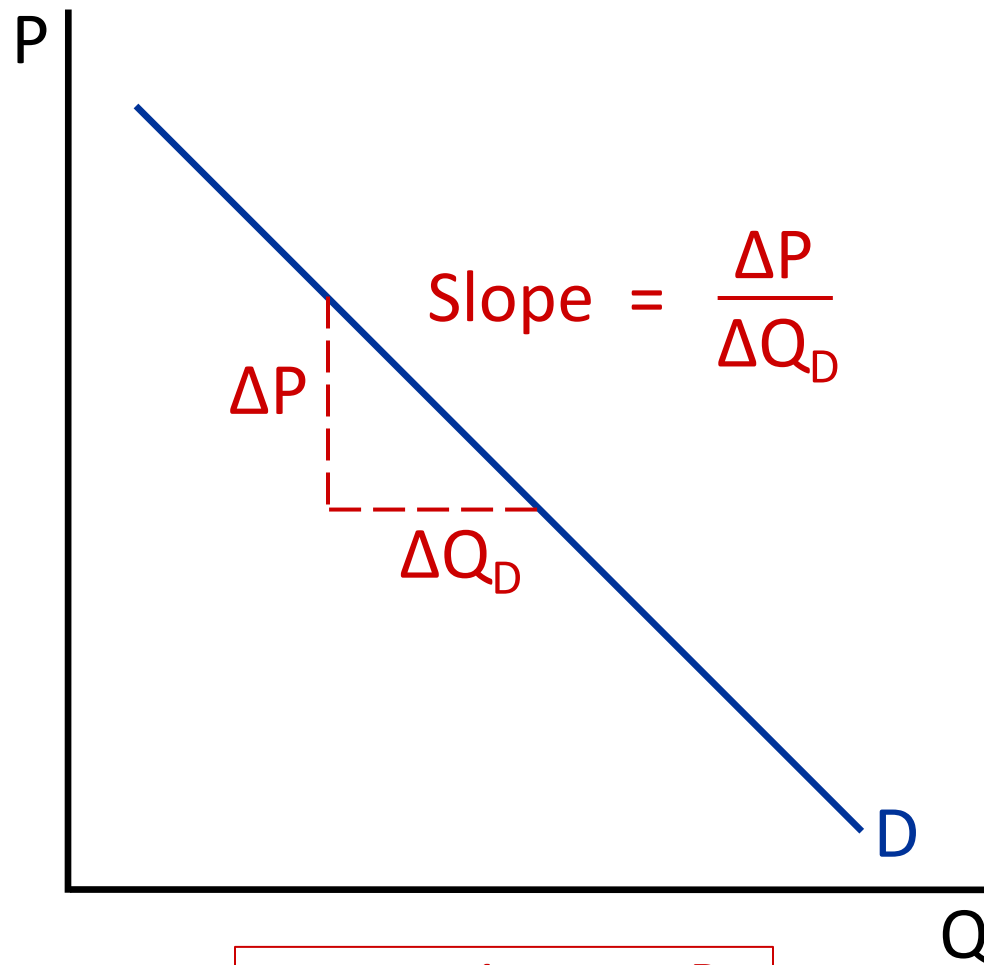
Slope of the Demand Curve

Slope of the Demand Curve

P

$$\text{Slope} = \frac{\Delta P}{\Delta Q_D}$$

ΔP

ΔQ_D

D

Q

Relationship between Demand Elasticity and the Slope of the Demand Curve

$$\varepsilon_D \;=\; \frac{\Delta Q_D \,/\, Q_D}{\Delta P \,/\, P}$$

$$=\; \frac{\Delta Q_D}{\Delta P} \;\cdot\; \frac{P}{Q_D}$$

$$=\; \frac{1}{\text{Slope}} \;\cdot\; \frac{P}{Q_D}$$

Slope of the Demand Curve

$$\text{Slope} = \frac{\Delta P}{\Delta Q_D}$$

$$\varepsilon_D = \frac{1}{\text{Slope}} \cdot \frac{P}{Q_D}$$

Slope of the Demand Curve

$$\text{Slope} = \frac{\Delta P}{\Delta Q_D}$$

Elasticity is generally not constant along the demand curve
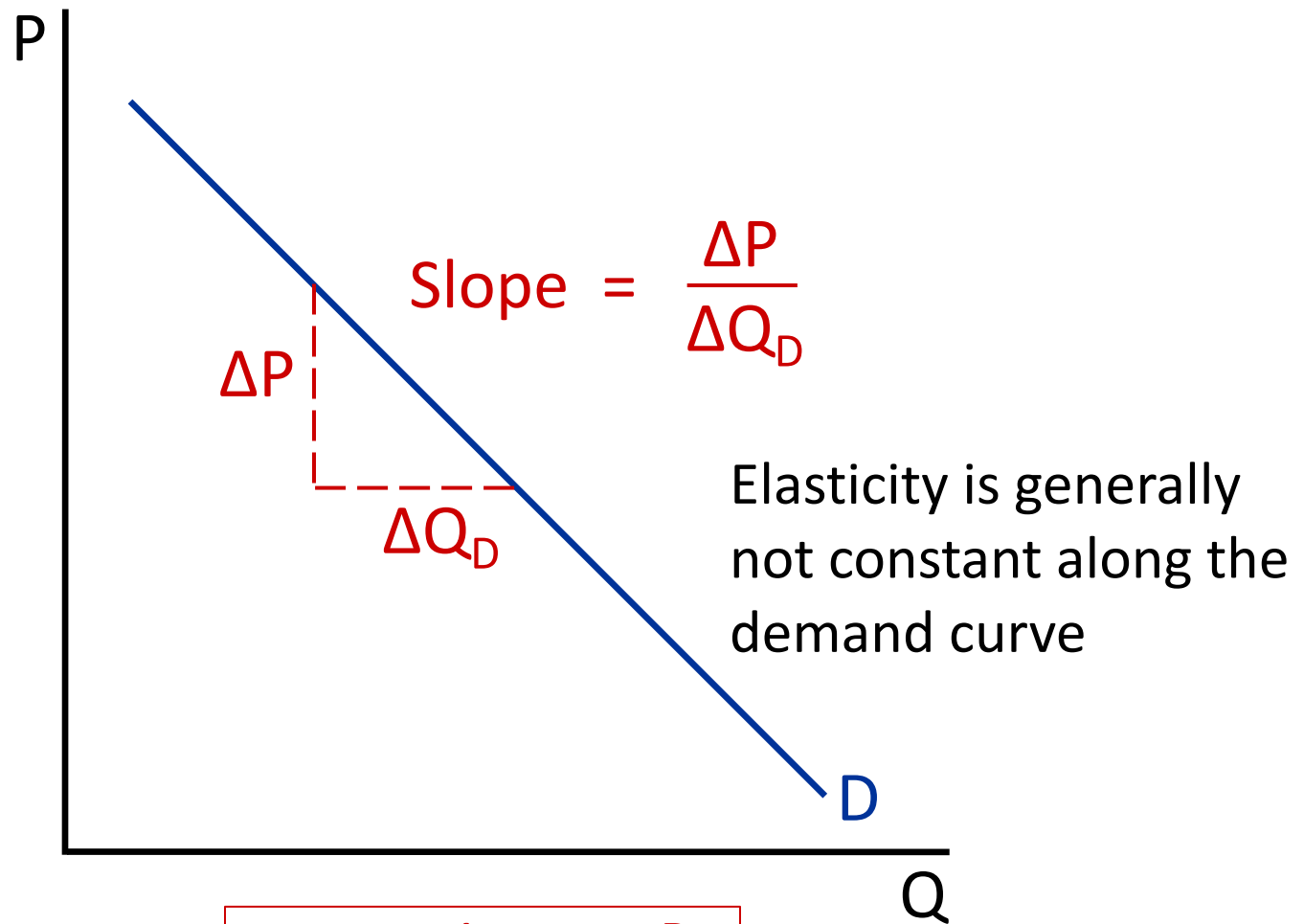
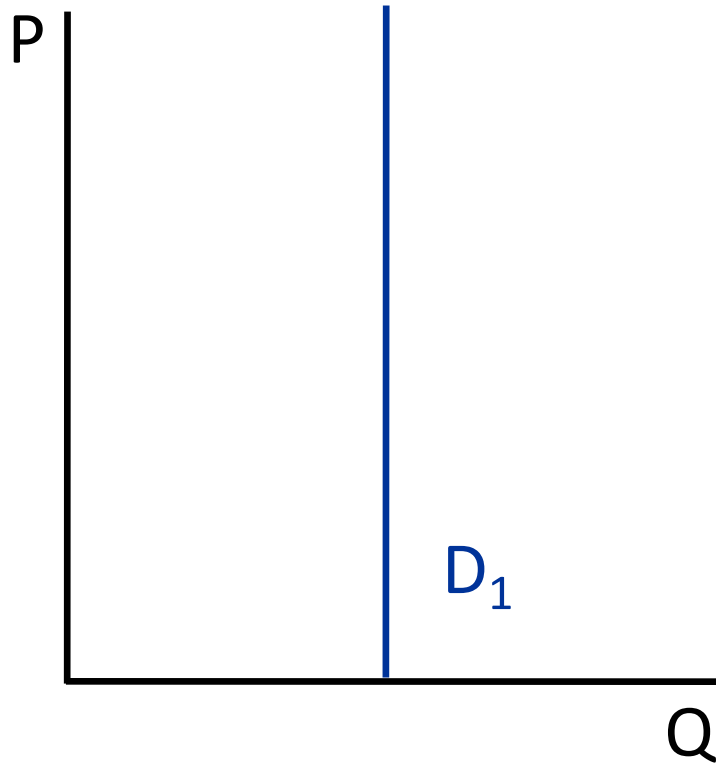$$\varepsilon_D = \frac{1}{\text{Slope}} \cdot \frac{P}{Q_D}$$

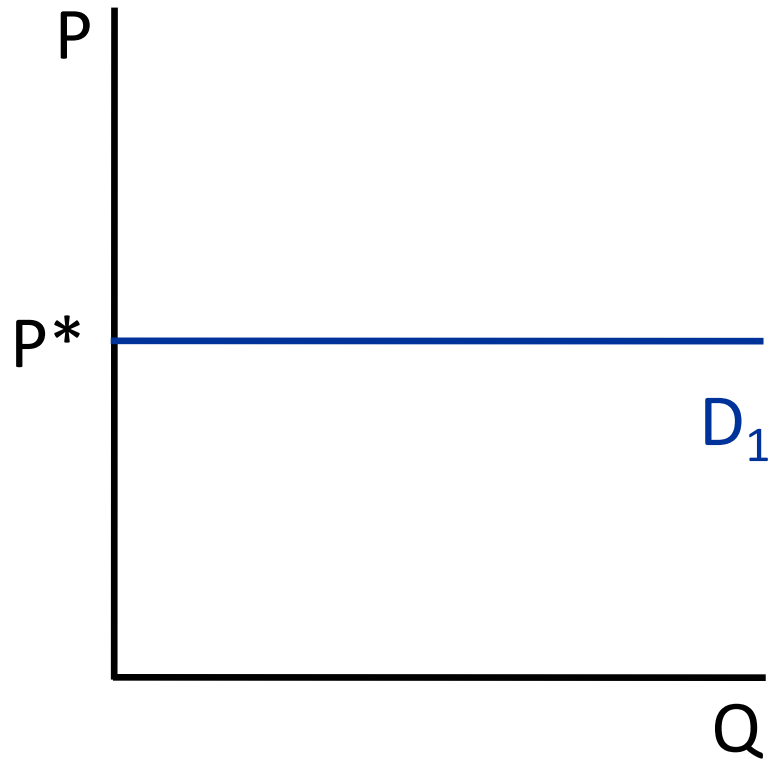# Elasticity is 1/slope of demand curve **when using a log-log scale**

Log P

$$1/\varepsilon_D = \text{Slope} = \frac{\Delta \log P}{\Delta \log Q_D}$$

$\Delta \log P$

$\Delta \log Q_D$

Elasticity is constant along the demand curve if log-log demand is a straight line

D

Log Q

$$\varepsilon_D = \frac{1}{\text{Slope}}$$
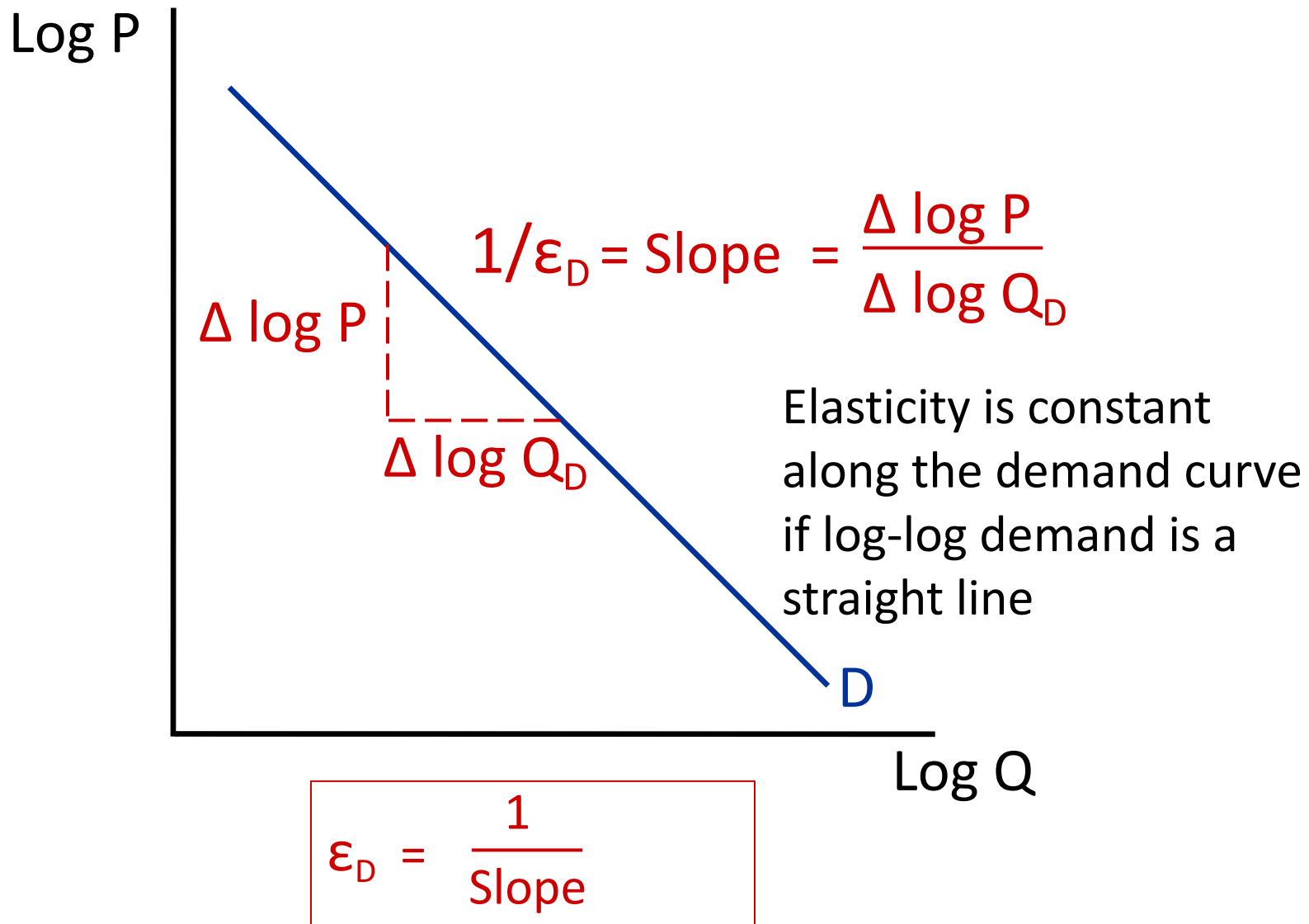
Demand Curves: limit cases

Perfectly Inelastic

P

D_1

Q

Demand fixed regardless of price
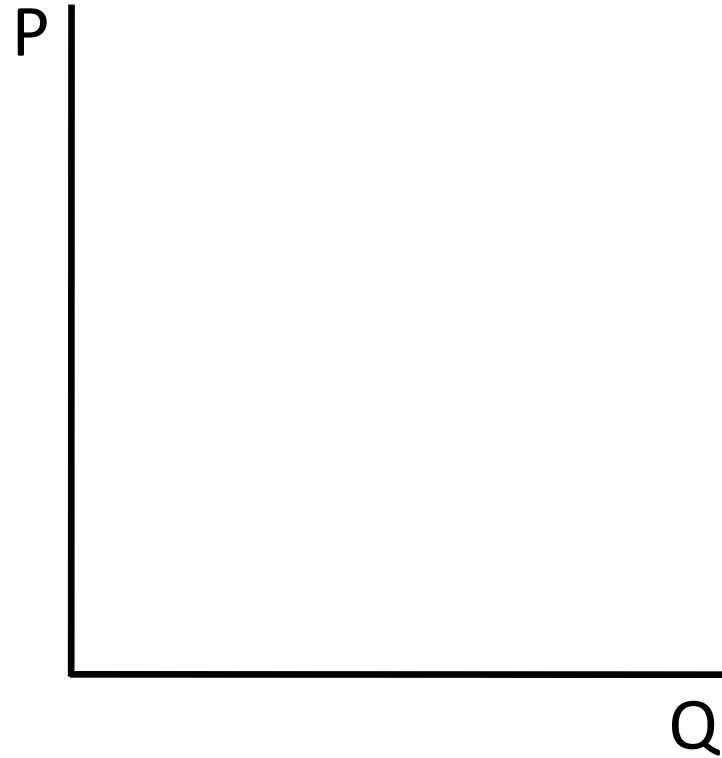Elasticity of demand = 0

Infinitely Elastic

P

P*

D_1

Q

Demand zero if P>P*, demand infinite if P<P*
Elasticity of demand = -infinite

Demand Curves
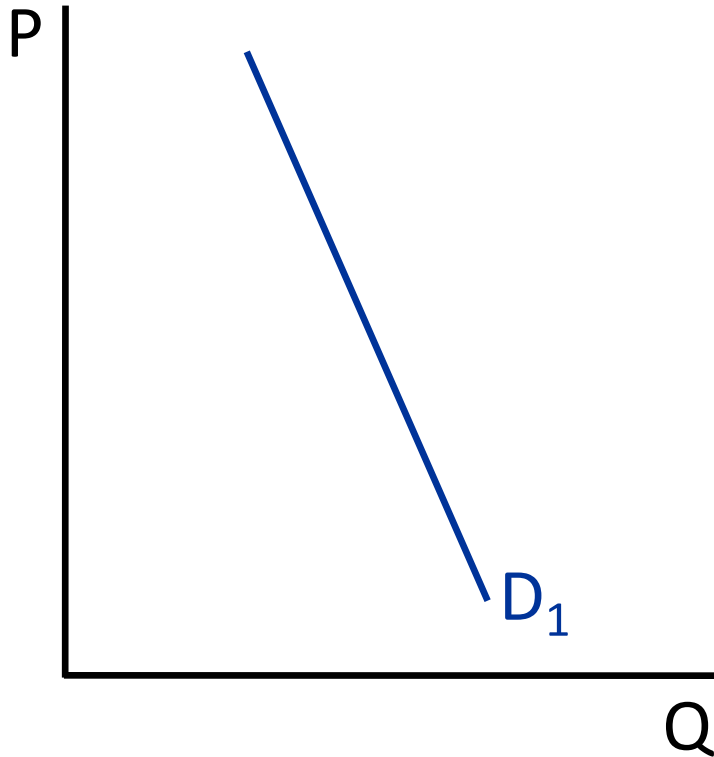
Inelastic

P

Q

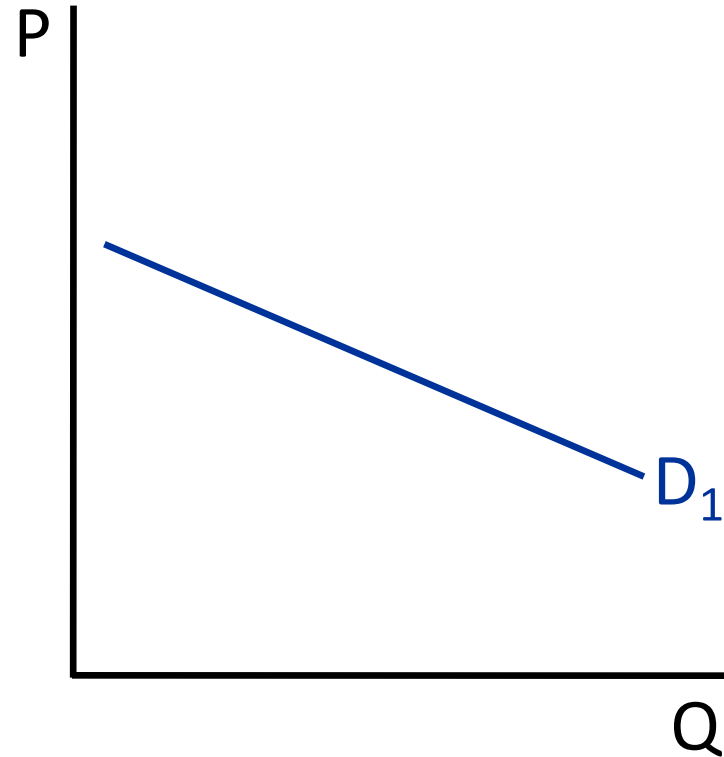## Elastic

P

Q

Demand Curves

Inelastic

P

Q

D$_1$
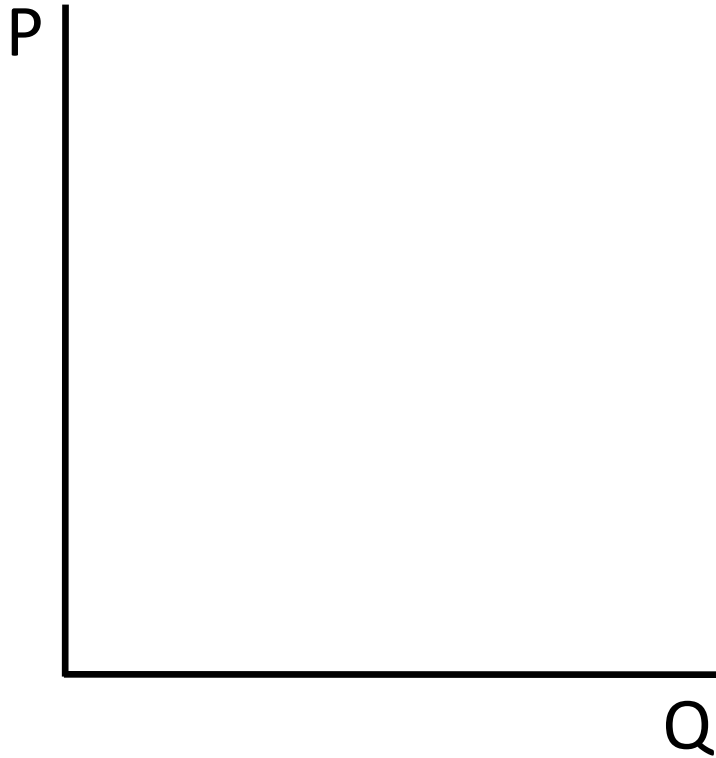
Demand is inelastic when demand curve is pretty steep
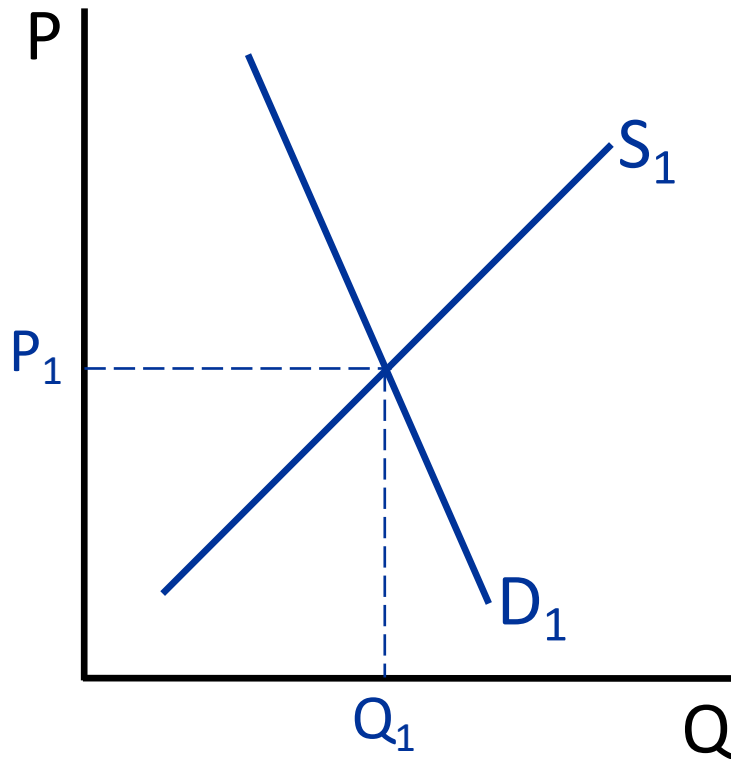
Elastic

P

Q

D$_1$

Demand is elastic when demand curve is fairly flat
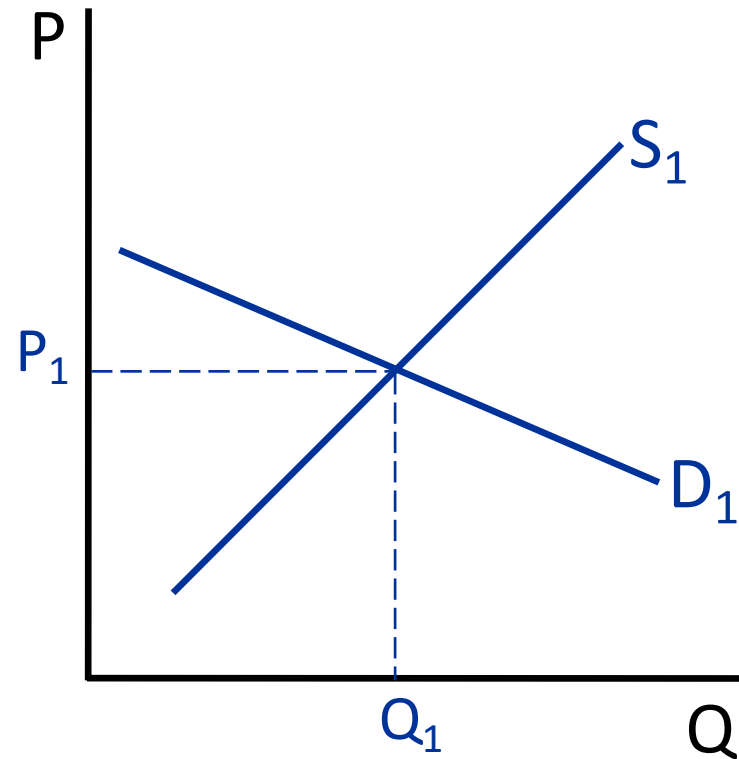
Price Elasticity of Demand

- Demand is inelastic when there is no close substitute and when consumers need the good

  - demand for gasoline is inelastic in short-run as you have to commute to work and can't afford to move closer to work or buy an electric car

- Demand is elastic when there is a close substitute or when consumers can do without the good

  - demand for gasoline is elastic in long-run as you switch to electric cars or move closer to work

Demand Elasticity Matters for Market Outcomes
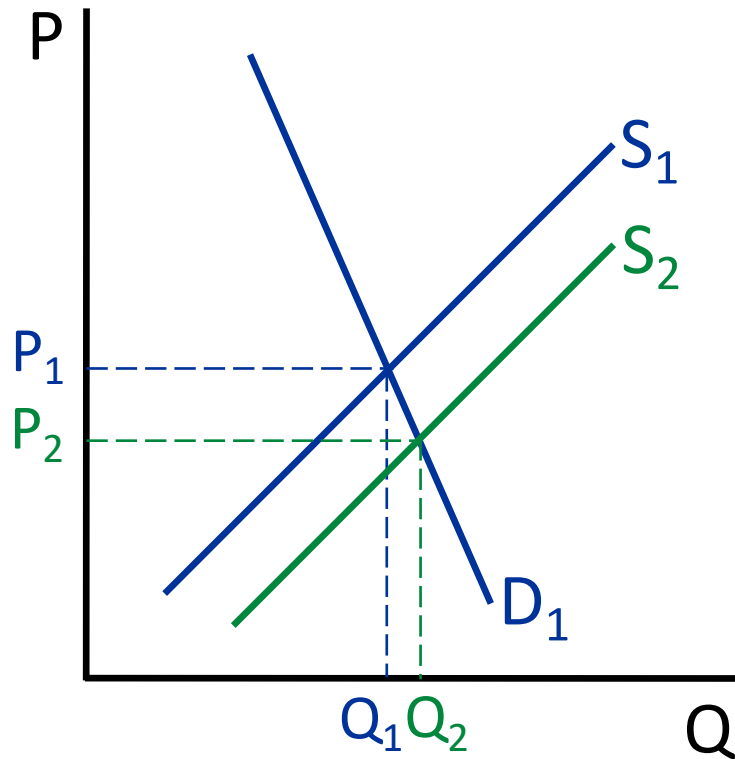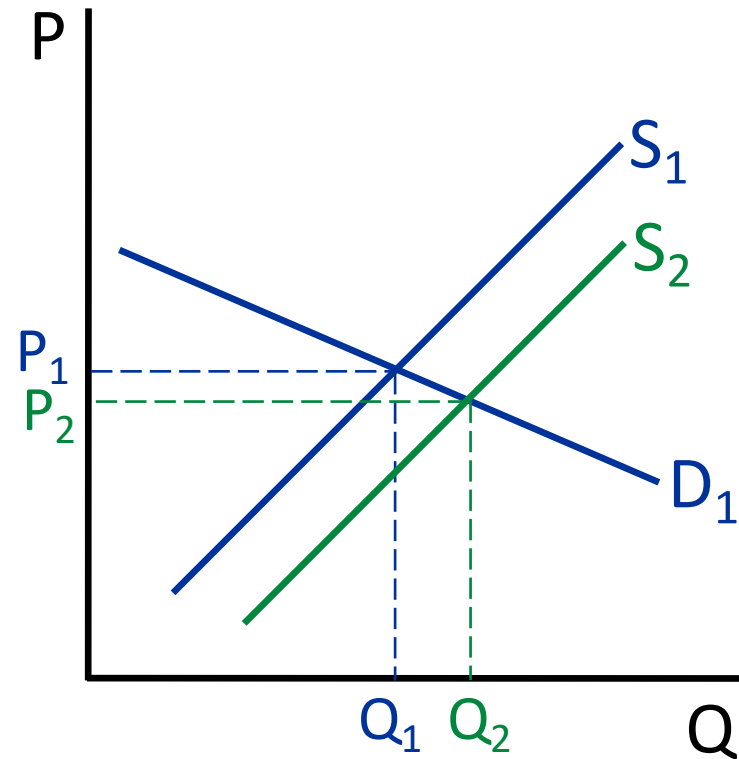## (Effect of a Shift Out in the Supply Curve)

Demand Elasticity Revealed by Supply Shift
(Effect of a Shift Out in the Supply Curve)

Total Expenditure
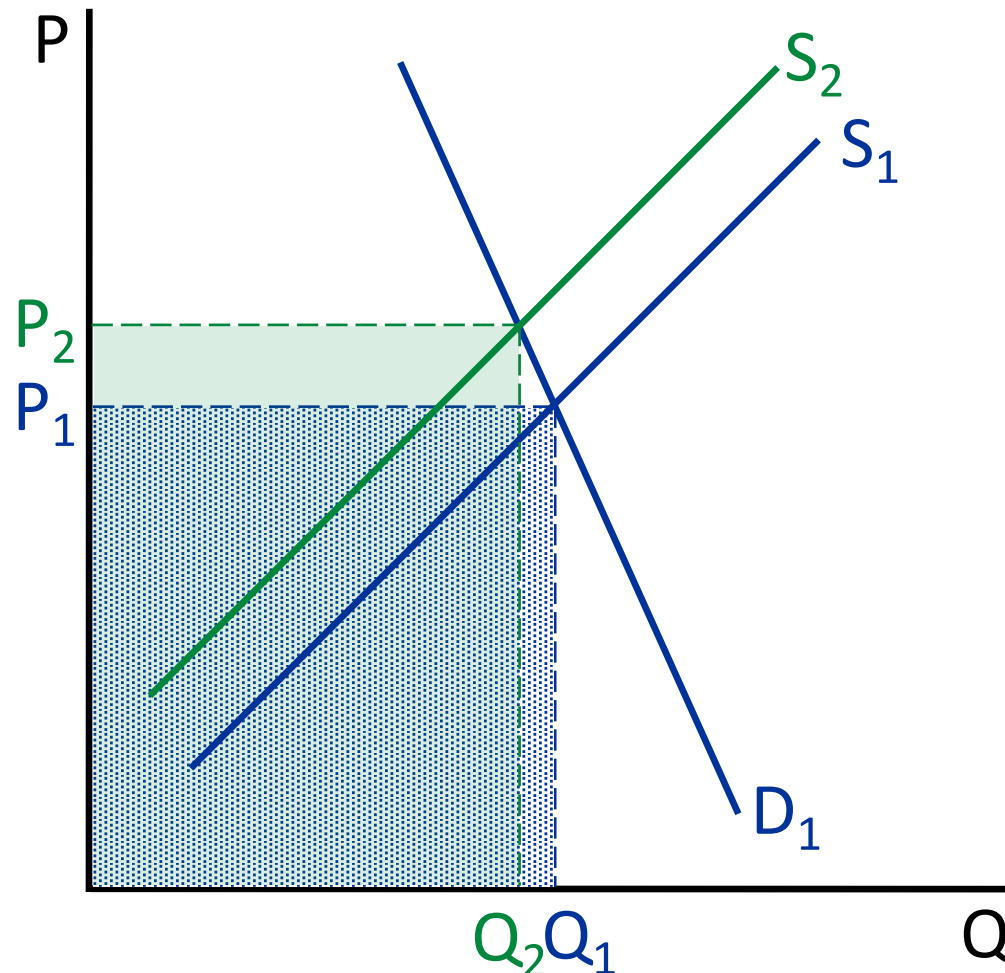
Total Expenditure = Price • Quantity

Does Total Expenditure Increase or Decrease with a Price Increase

With $\varepsilon_D < 1$, percent drop in Q (blue loss) is smaller than percent increase in P (green gain) => expenditure rises

Demand Elasticity and Expenditure

- Inelastic ($\varepsilon_D < 1$): Total expenditure rises when the supply curve shifts back.

- Elastic ($\varepsilon_D > 1$): Total expenditure falls when the supply curve shifts back.

- Textbook example: if demand for illicit drug is inelastic then cracking down that increases price of illicit drug would increase expenditures on them

- But: at sufficiently high prices, demand always becomes elastic (because budget is finite)

Price Elasticity of Supply (ε_S)

$$\varepsilon_S = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$
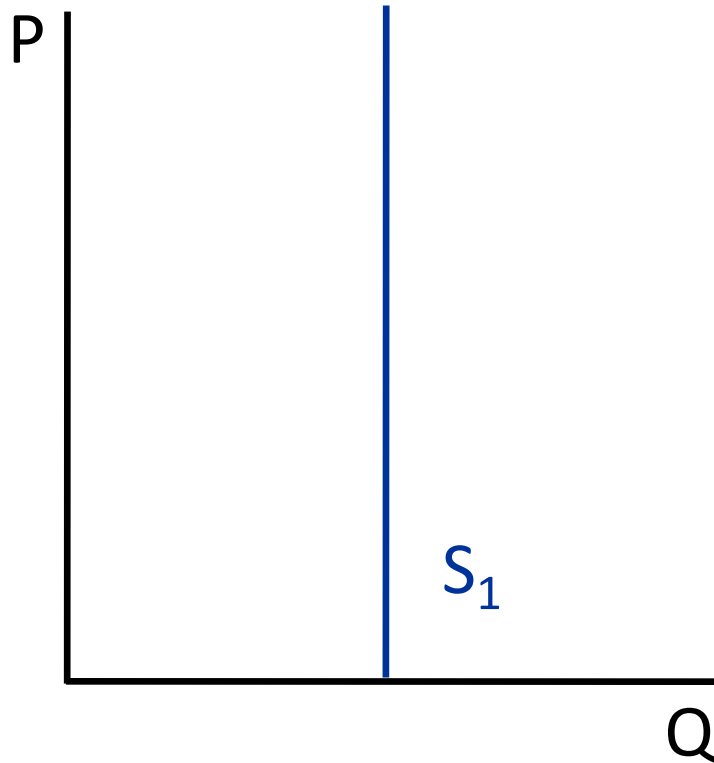
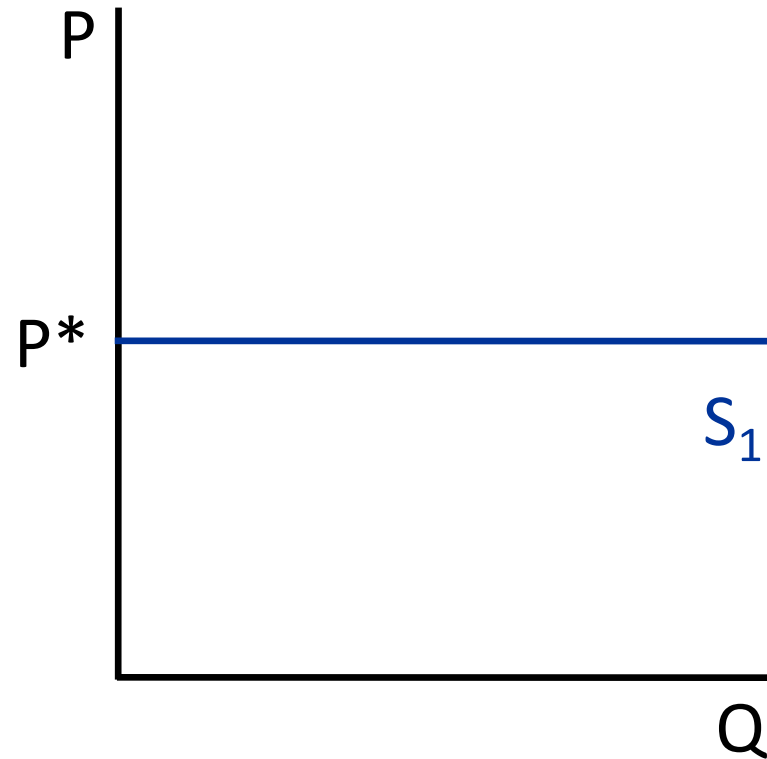|	
Elastic	$\varepsilon_S > 1$
Inelastic	$\varepsilon_S < 1$
Perfectly inelastic	$\varepsilon_S = 0$
Perfectly elastic	$\varepsilon_S = \infty$

Supply Curves: limit cases

Perfectly Inelastic
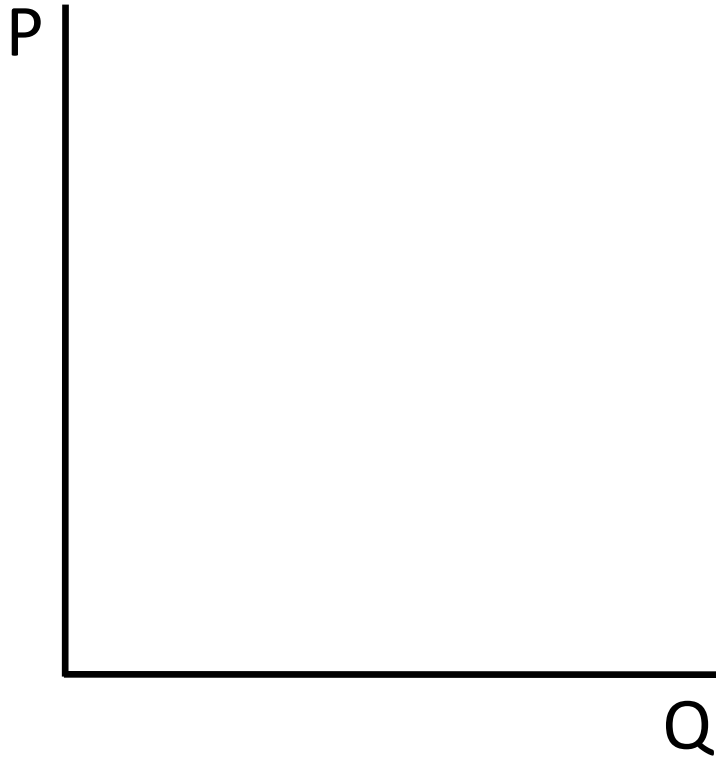

Supply fixed regardless of price
Elasticity of supply = 0

Infinitely Elastic

Supply zero if P>P*, supply
infinite if P<P*
Elasticity of supply = infinite

Supply Curves

Inelastic

P

Q

Elastic

P

Q

Supply Curves

Inelastic

P

S_1

Q

Elastic

P

S_1

Q
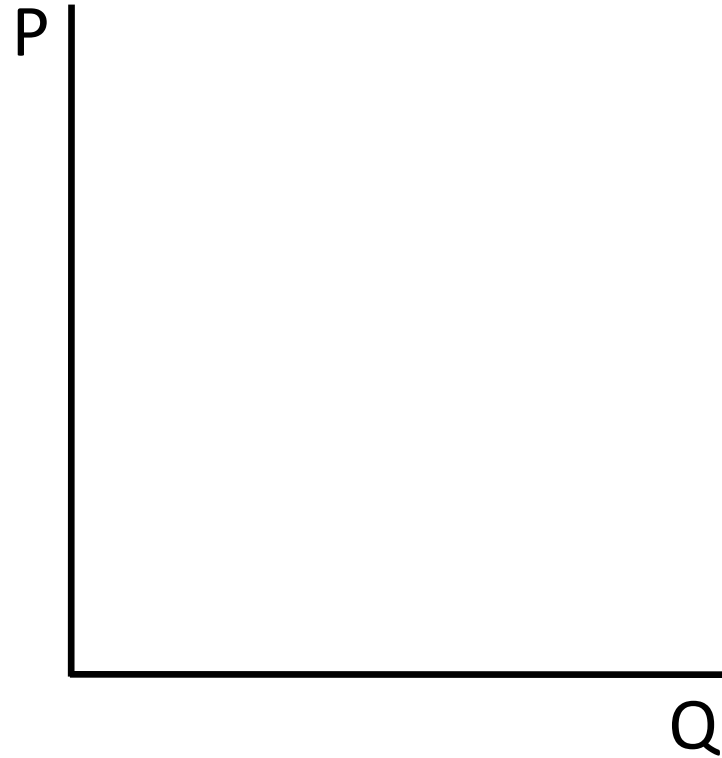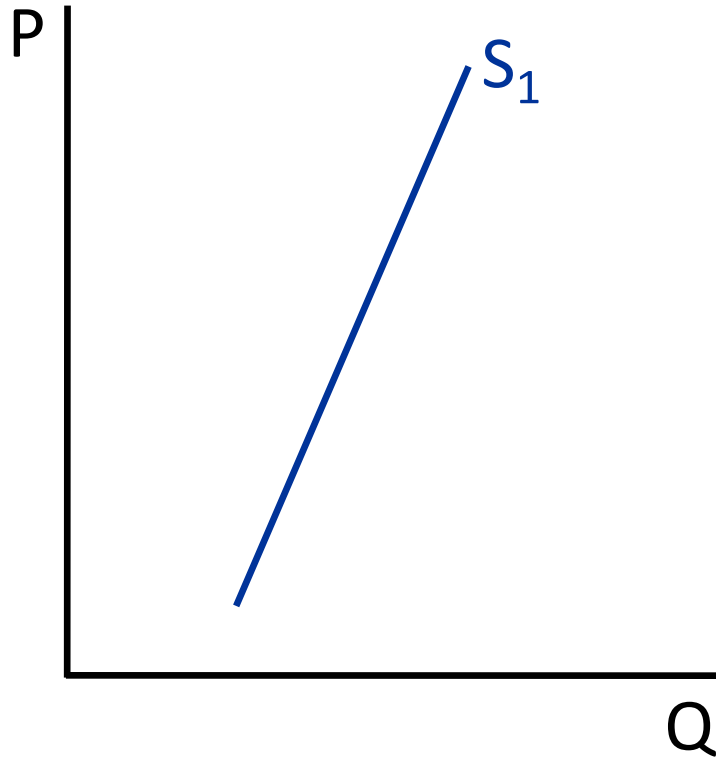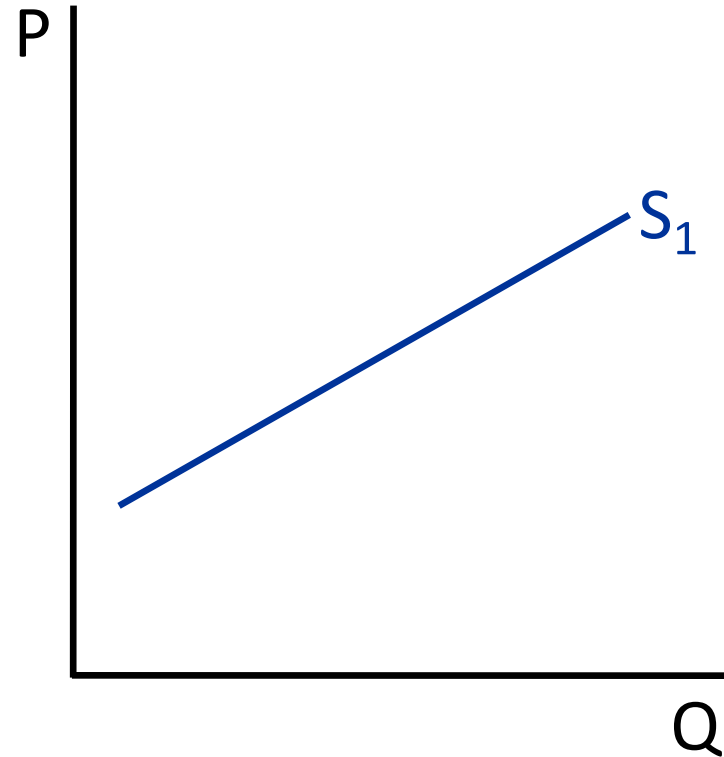
As with the ε_D, the relationship between ε_S and the slope of the supply curve is a useful, but crude approximation.
Supply elasticity is revealed by shift of demand curve

Price Elasticity of Supply

- Supply is inelastic when there is a resource constraint (typically short-run)

  - Supply for oil is inelastic in short-run as it takes time to explore and drill new oil wells. Same with agricultural products

- Supply is elastic when there are no hard resource constraints (typically long-run)

  - Supply for oil elastic in long-run as you develop new fracking technologies, etc.

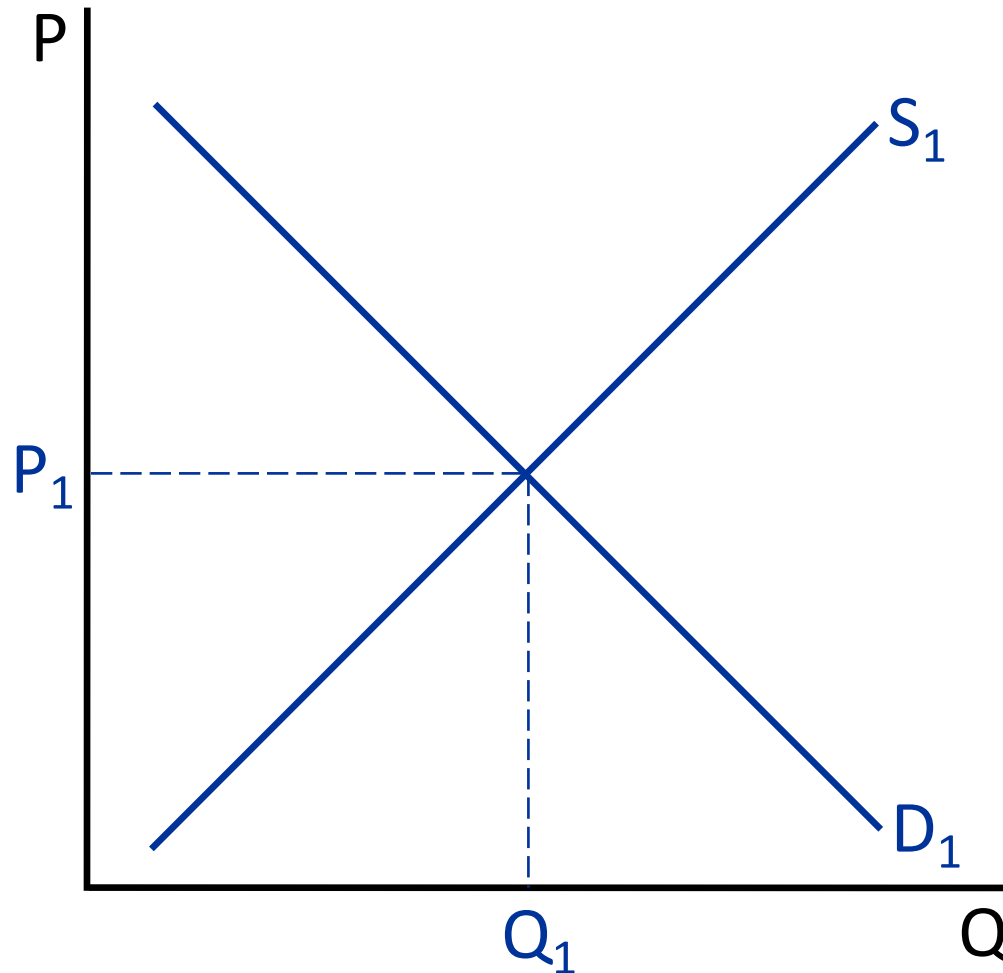# Quiz:

Question: Suppose that supply is inelastic ($\varepsilon_S < 1$) and that there is a demand shift outward. What happens to expenditure P*Q?

- A. It increases if demand is inelastic

- B. It always increases

- C. It increases if demand is elastic

- D. I don't know

III. EFFECTS OF A TAX

Effect of a New 50¢ per Gallon Tax on Gasoline
(Physically Collected from Producers)

Effect of a New 50¢ per Gallon Tax on Gasoline
(Physically Collected from Producers)
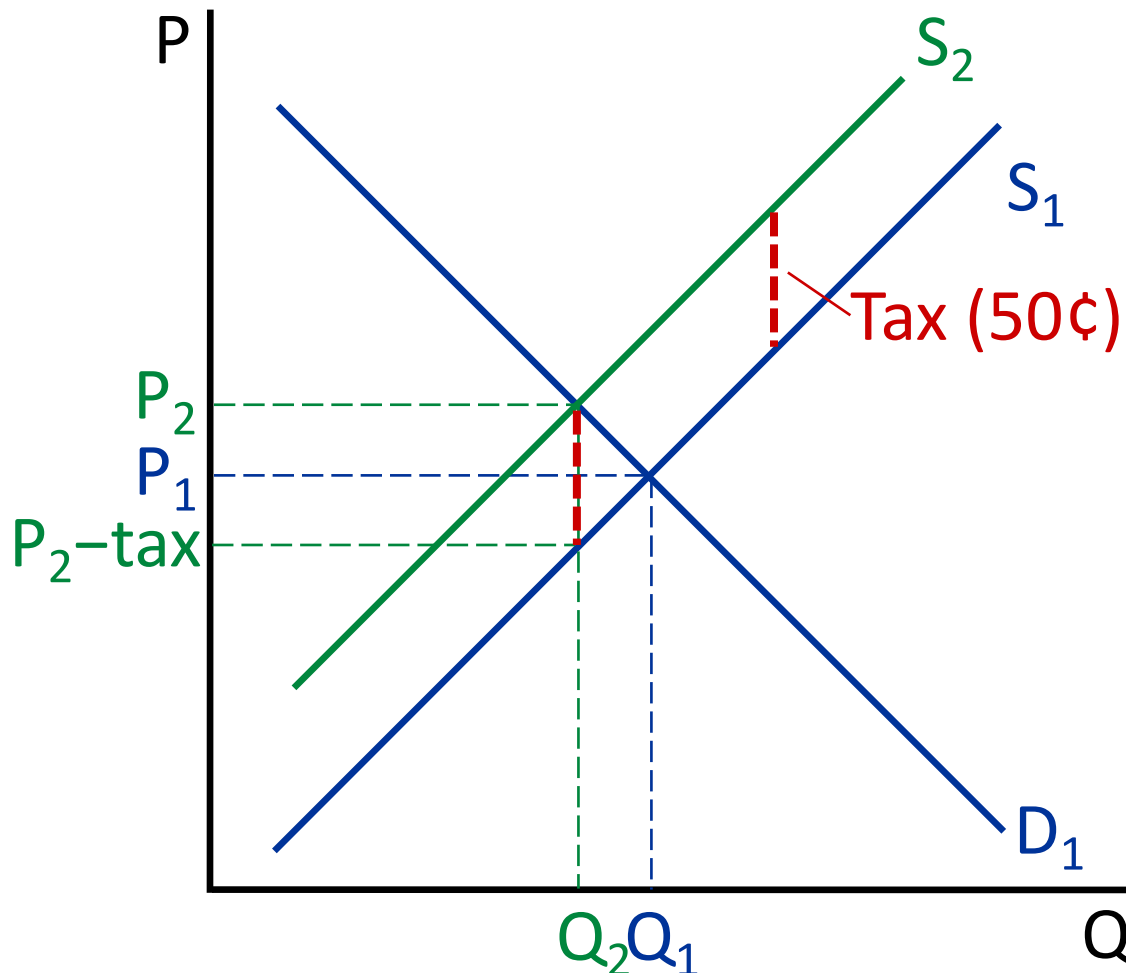
Tax collected on producers shifts supply or MC curve upward:
Tax is like an extra Marginal Cost producers have to pay

Effects of a Tax

- Quantity bought and sold declines.

- Production and consumption are still allocated by price.

- Price rises by less than the amount of the tax.

- Both sides feel the effects of the tax.

- A tax collected from the consumer (instead of the producer) generates the exact same equilibrium:

  - same quantity, same price of consumer, same price for producer

Tax collected from consumer has exact same effect as tax collected from producer
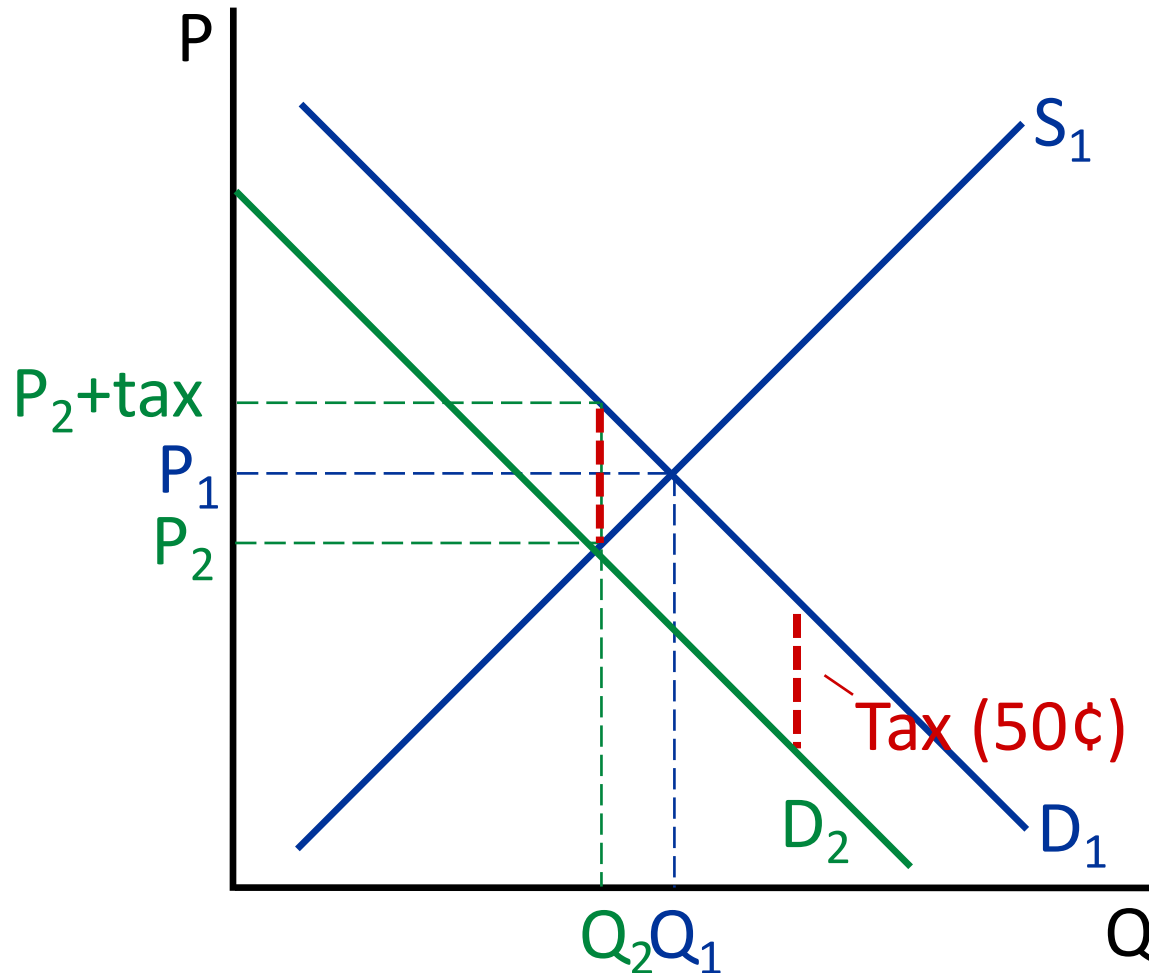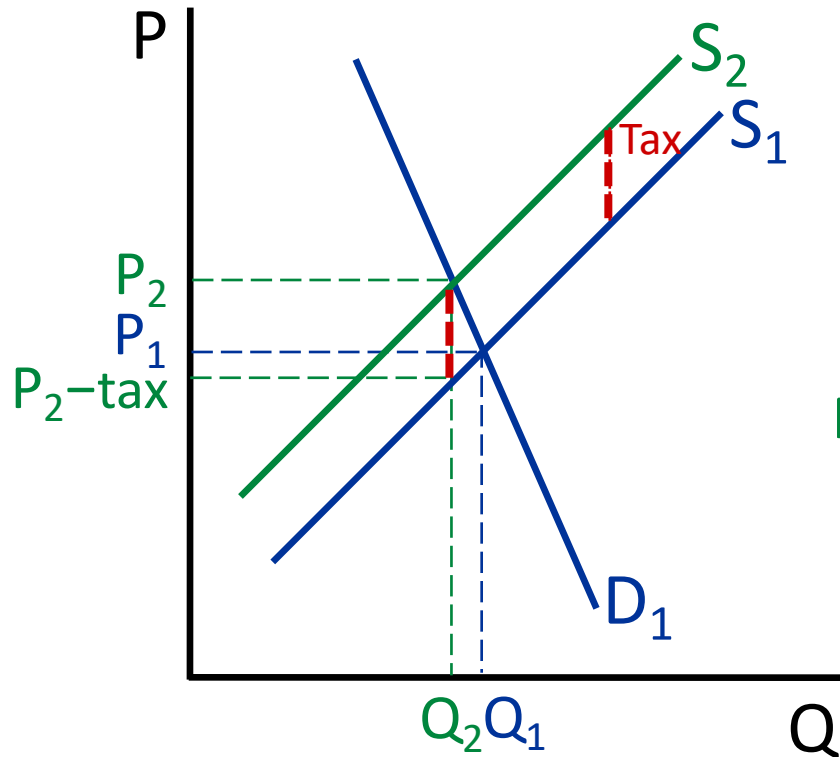

Tax collected on consumers shifts demand or MB curve downward:
Tax is like a negative Marginal Benefit consumers have to pay

Demand Elasticity and the Effects of a Tax

Inelastic

P

S_2

S_1

Tax

P_2
P_1
P_2-tax

D_1

$Q_2 Q_1$ Q

Elastic

P

S_2

S_1

Tax

P_2
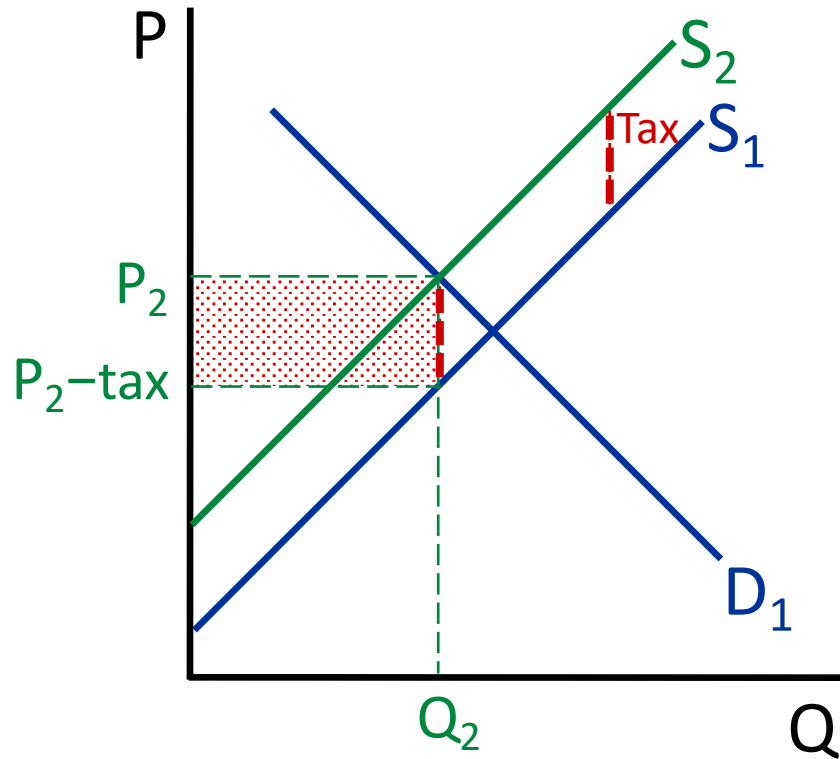P_1
P_2-tax

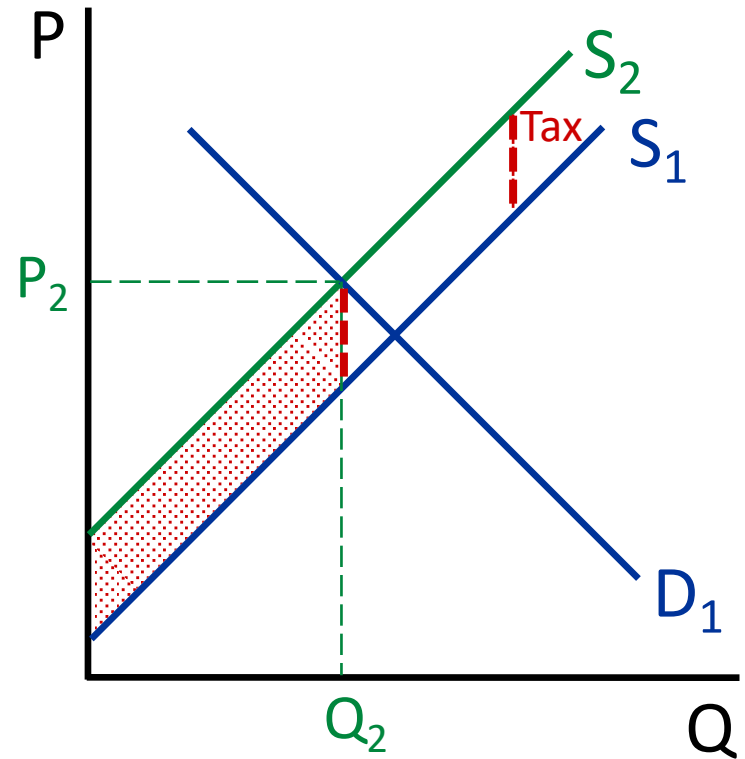D_1

$Q_2\ Q_1$ Q
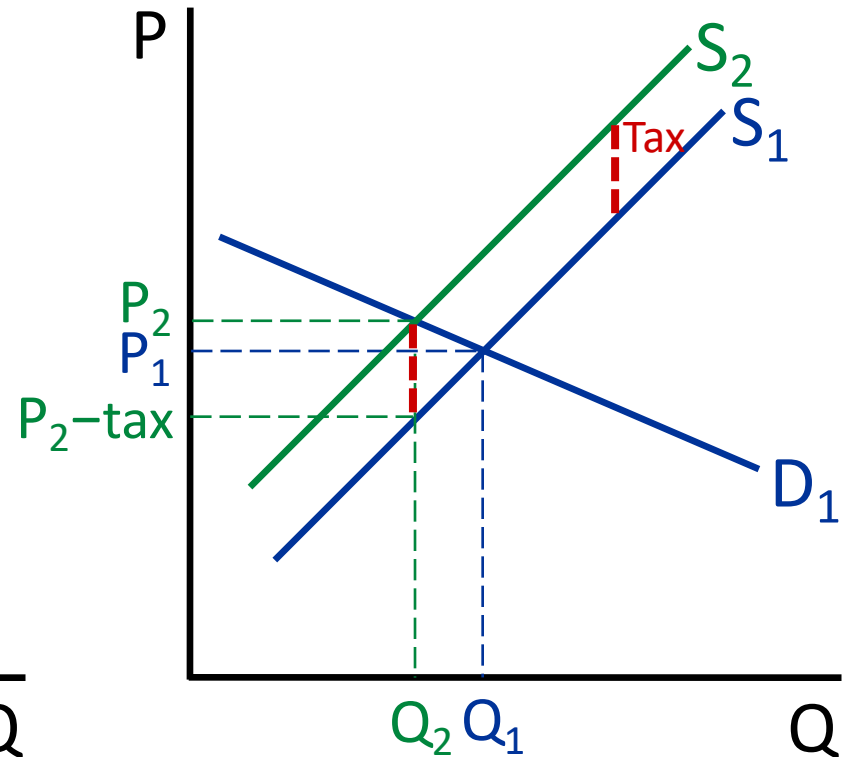
Two Ways of Visualizing Tax Revenues

(1)   (2)

Tax Revenue = Tax • Q_2

Demand Elasticity and Tax Revenue

Inelastic
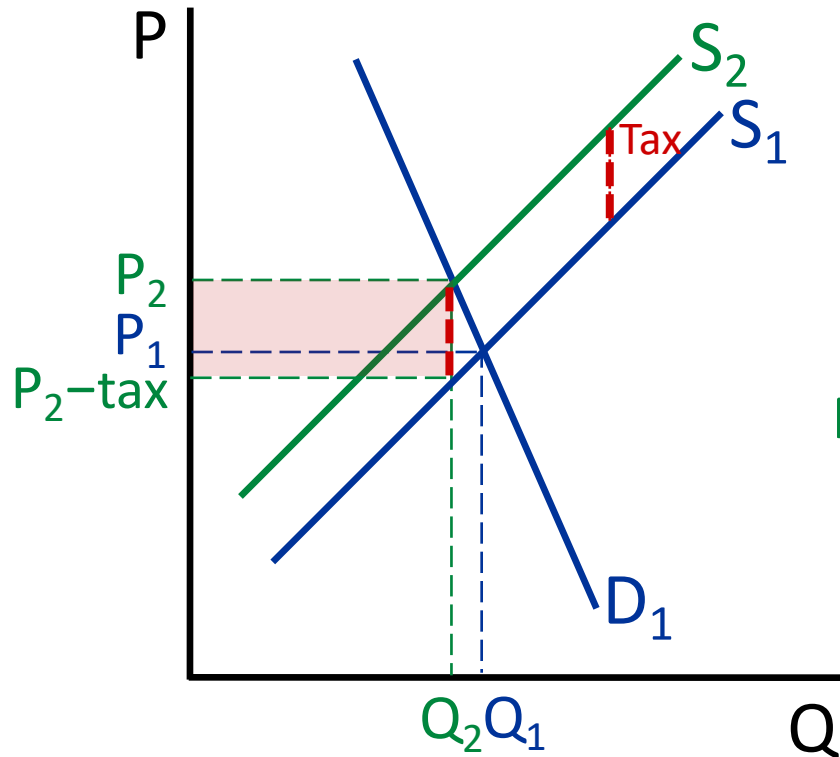
Elastic
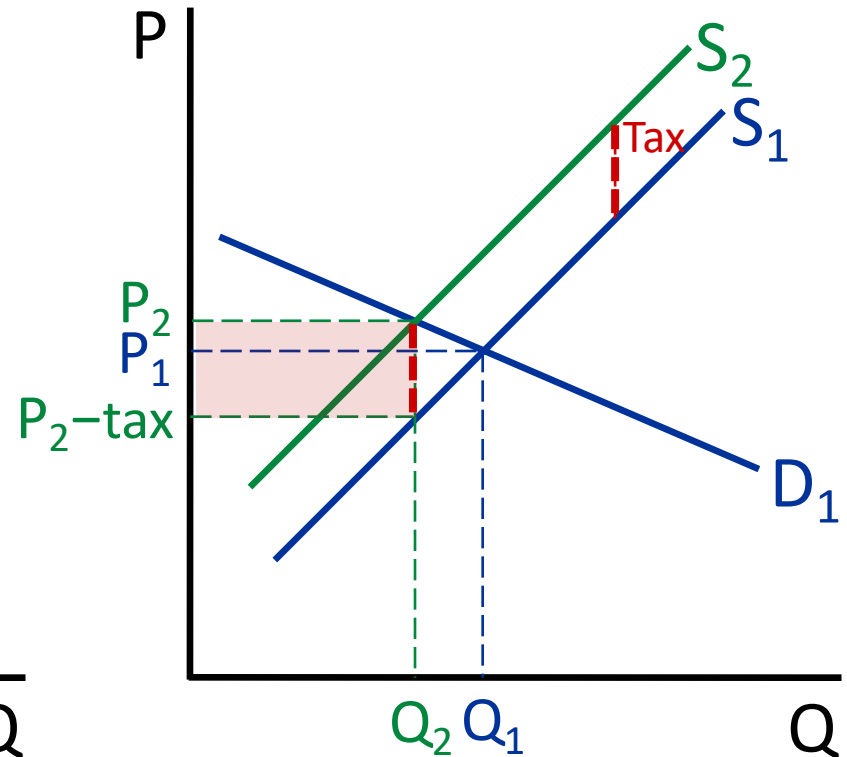
When demand is elastic: P_2 close to P_1, consumers don't see a big change in price due to tax, producers bear the tax

Demand Elasticity and the Effects of a Tax

- A tax will change the equilibrium quantity more, the more elastic demand (or supply) is.

- Consumers will bear more of the tax (and producers will bear less of the tax), the less elastic demand is

- Producers will bear more of the tax (and consumers will bear less of the tax), the less elastic supply is

- **Key lesson:** inelastic factors bear the tax while elastic factors avoid the tax

Quiz:

Question: Suppose that an extra 50c/gallon gas tax is introduced in California. What happens to the price of gas you pay at the pump (in the competitive supply-demand model)?

- A. It increases by exactly 50c/gallon

- B. It increases by less than 50c/gallon

- C. It increases by more than 50c/gallon

- D. Options A, B, C can all be correct, it depends on supply and demand elasticities.

Empirical Evidence: Gasoline Taxes

- Some countries (e.g. Europe) impose much higher gas taxes than others (e.g. US)

- Gasoline prices are correspondingly much higher in Europe than in the US => tax is mostly borne by consumers

- Suggests that supply of gasoline for cars is much more elastic than demand

  - Supply of gasoline is world oil price + costs of running gas station (likely very elastic)

  - Demand for gasoline inelastic in short-run

How High Are Gas Taxes in Your State?

Total State Taxes and Fees on Gasoline, July 2020 (cents per gallon)

WA 49.40¢ #4
OR 38.83¢ #11
MT 32.75¢ #22
ID 33.00¢ #20
ND 23.00¢ #40
MN 28.60¢ #30
WI 32.90¢ #21
MI 41.98¢ #9
NY 43.12¢ #7
VT 30.17¢ #26
NH 23.83¢ #39
ME 30.01¢ #27
SD 30.00¢ #28
IA 30.50¢ #25
WY 24.00¢ #38
NE 34.10¢ #18
IL 52.01¢ #3
IN 47.62¢ #5
OH 38.51¢ #12
PA 58.70¢ #2
NV 33.78¢ #19
UT 31.11¢ #24
CO 22.00¢ #42
KS 24.03¢ #37
MO 17.42¢ #49
KY 26.00¢ #34
WV 35.70¢ #16
VA 29.40¢ #29
CA 62.47¢ #1
AZ 19.00¢ #46
NM 18.88¢ #47
OK 20.00¢ #44
AR 24.80¢ #35
TN 27.40¢ #31
NC 36.35¢ #13
SC 24.75¢ #36
MS 18.79¢ #48
AL 27.21¢ #32
GA 32.20¢ #23
TX 20.00¢ #44
LA 20.01¢ #43
FL 42.29¢ #8
AK 13.77¢ #50
HI 46.28¢ #6

MA 26.54¢ #33
RI 35.00¢ #17
CT 35.75¢ #15
NJ 41.40¢ #10
DE 23.00¢ #40
MD 36.30¢ #14
DC 23.50¢ (#40)

Total State Taxes and Fees on Gasoline, July 2020 (cents per gallon)
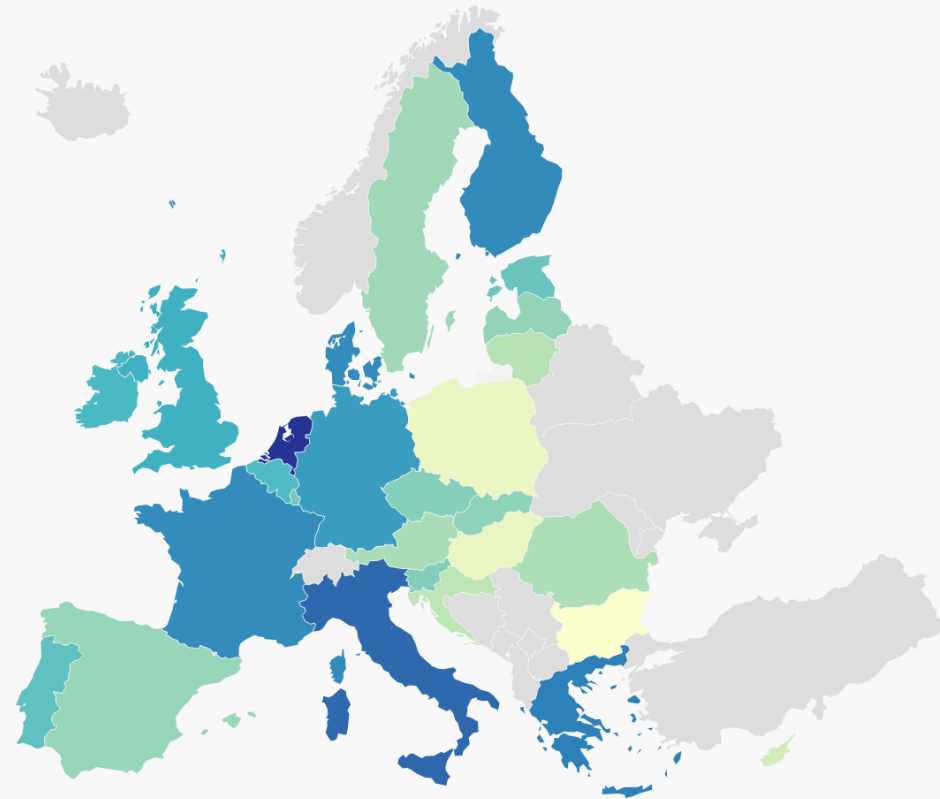
Lower ————————————— Higher

Note: These rates do not include the 18.4 cent/gallon federal excise tax rate on gas. The American Petroleum Institute has developed a methodology for determining the average tax rate on a gallon of fuel. Rates may include any of the following: excise taxes, environmental fees, storage tank taxes, other fees or taxes, and general sales taxes. In states where gasoline is subject to the general sales tax, or where the fuel tax is based on average sale price, the average rate determined by API is sensitive to changes in the price of gasoline. D.C.'s rank does not affect states' ranks, but the figure in parenthese indicates where it would rank if included. Data as of July 2020.

Source: American Petroleum Institute, "Notes to State Motor Fuel Excise and Other Taxes."

Gas Taxes in Europe

Excise Duty per Liter of Unleaded Petroleum in EU Member States and the United Kingdom, 2024

€0.359   €0.789

TAX FOUNDATION | EUROPE

Download data by country at
https://taxfoundation.org/data/all/eu/gas-taxes-in-europe-2024/

(AUGUST 1st 2024)

Petrol Prices in the EU

- 1,33 - 1,51
- 1,51 - 1,59
- 1,59 - 1,71
- 1,71 - 1,82
- 1,82 - 2,05

Price in EUR/liter 1st August 2024

- Non-EU Countries

1.84
1.58
1.72
1.66
1.48
2.05
1.51
1.78
1.99
1.8
1.5
1.71
1.56
1.59
1.6
1.82
1.55
1.51
1.85
1.61
1.33
1.71
1.61
1.88
1.34

Download data by country at
https://www.mappr.co/thematic-maps/fuel-prices-europe/
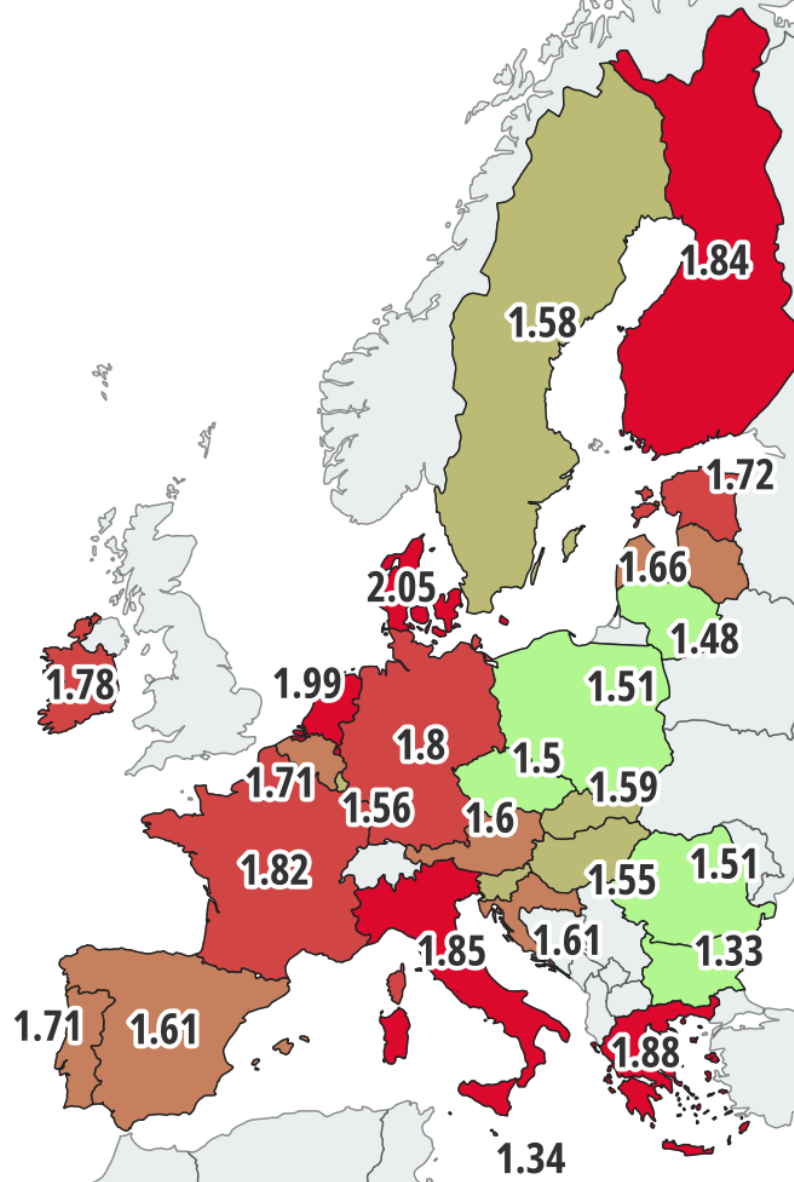
VAT increases vs. decreases study

- European countries have large consumption taxes: Value Added Tax (VAT)

- Normal VAT rates are high (around 20%) but some goods/services have lower rates (or are exempt)

- Benzarti et al. (2020) study the effects of VAT rates increases vs. decreases

- Nice illustrative case study: hairdressers in Finland got a VAT cut of 14 points in Jan 2007 that was repealed in Jan 2012

- Provide a basic graphical analysis of prices of hairdressers (treatment) with beauty salons (control)

Figure 1: Finnish Hairdressing Sector VAT Reforms

Source: Benzarti et al. (2017)
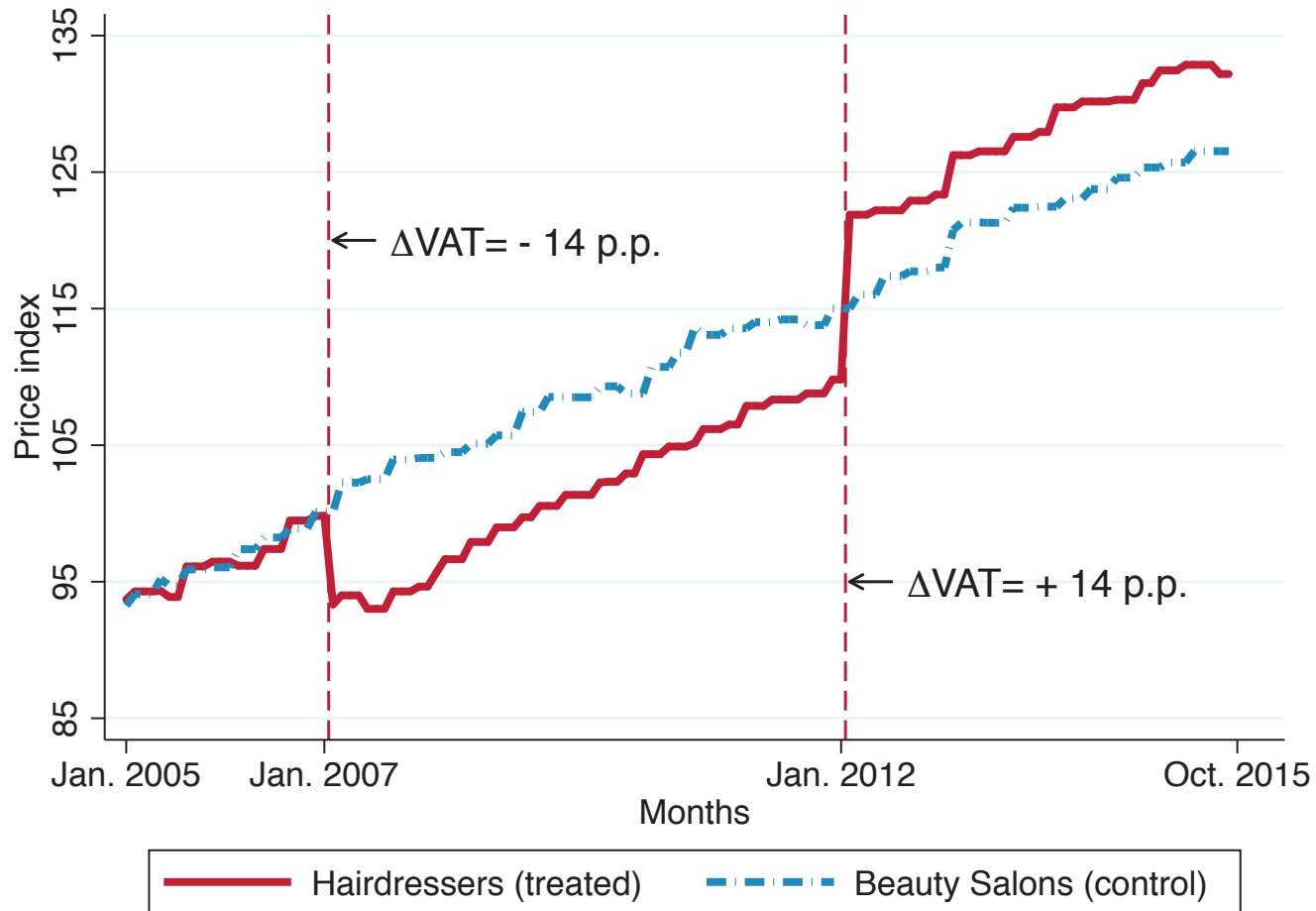
Notes: This figure shows the price of hairdressing services and beauty salons before and after the 14 percentage point hairdressing services VAT cut in January 2007 and the 14 percentage point VAT hairdressing services hike in January 2012.

VAT increases vs. decreases puzzle

- Study finds that tax decreases are only 50% passed on consumers while tax increases are almost fully passed on consumers.

- Most likely explanation: producers pocket tax cut because consumers are inattentive to taxes.

- Producers pass tax increase because they can justify the price increase to consumers.

- Price determination does not work like basic competitive model. We should not take its predictions as gospel!
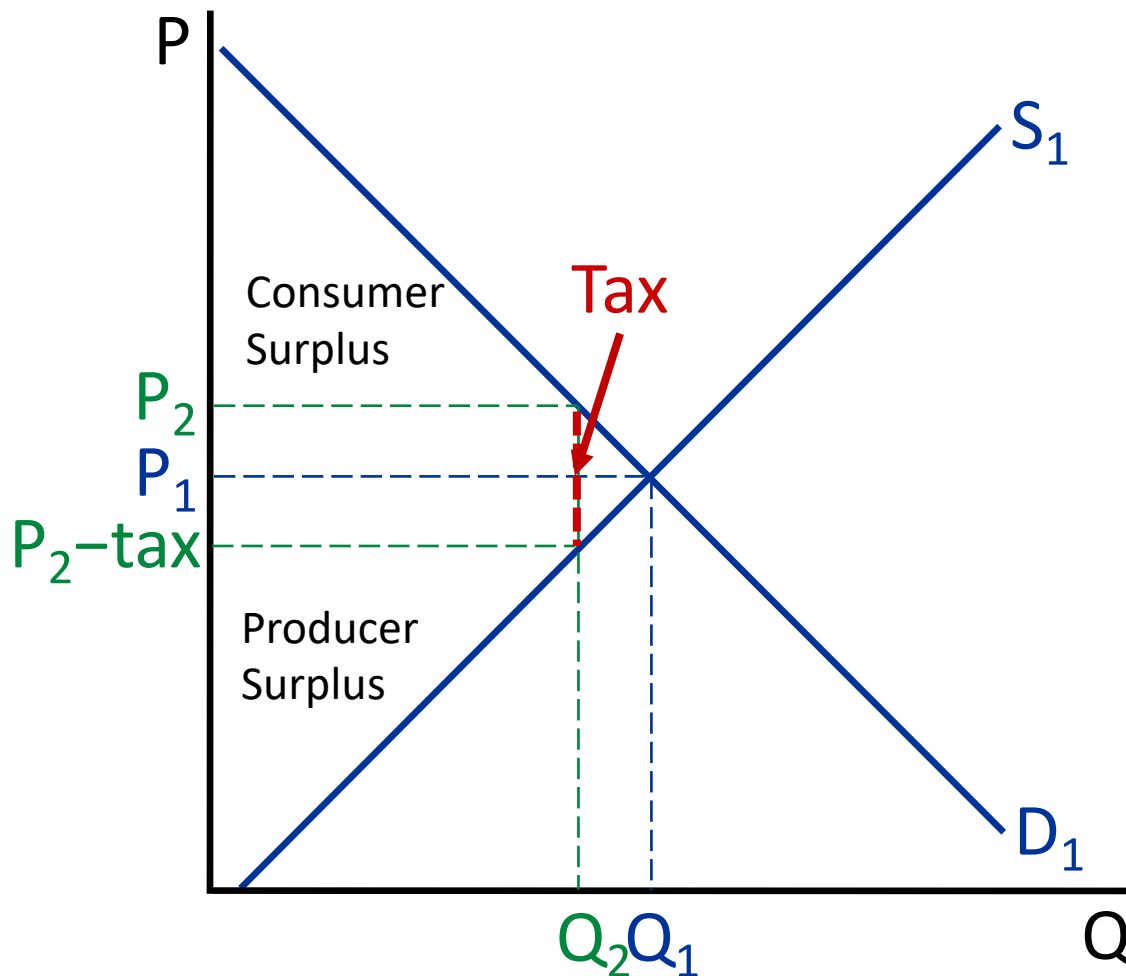
IV. Welfare Analysis of a Tax

Welfare Analysis of a Tax:
Start with equilibrium with no taxes
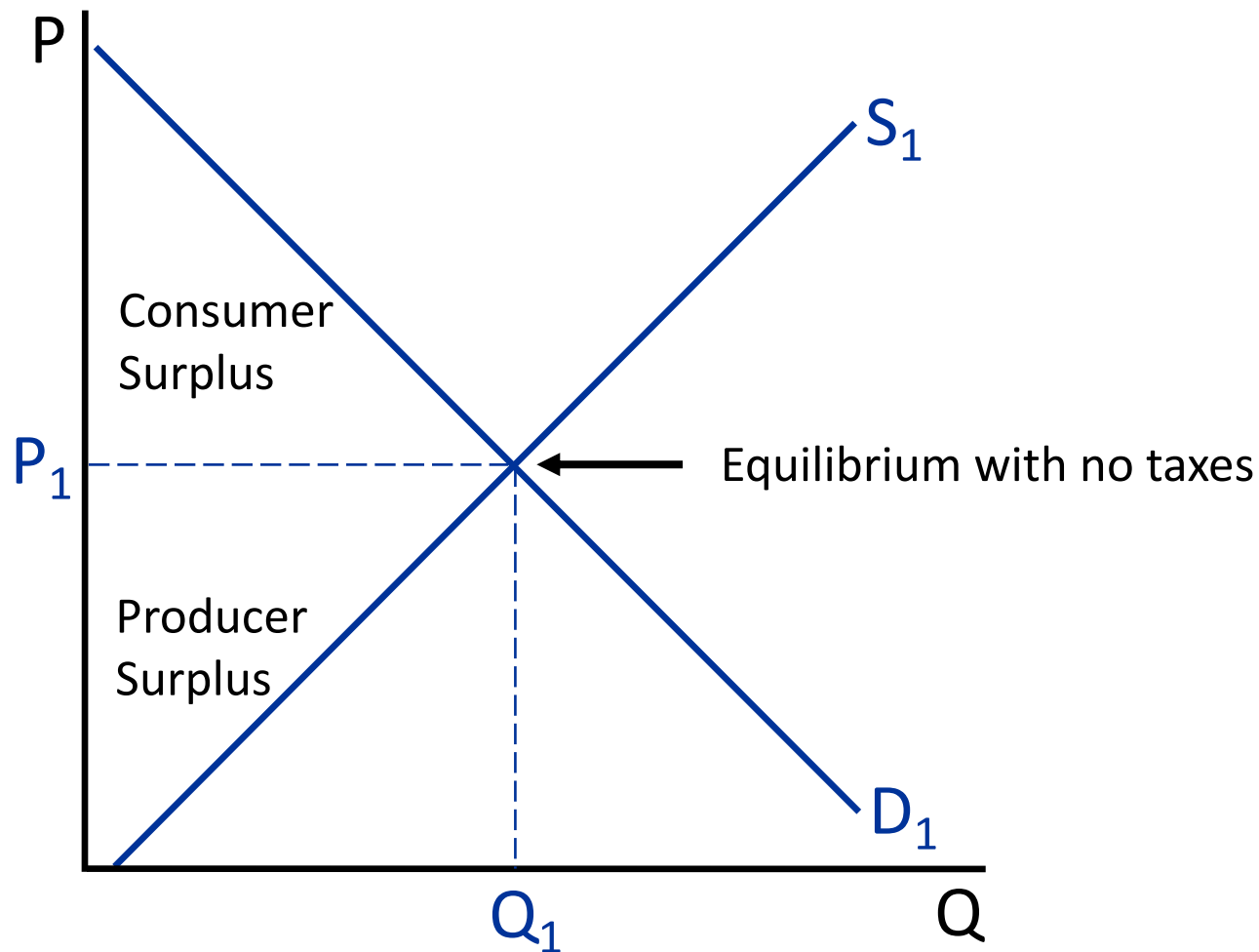
Welfare Analysis of a Tax:
Introducing a tax affects P and Q

Welfare Analysis of a Tax:
Tax extracts surplus from consumers and producers and creates deadweight loss
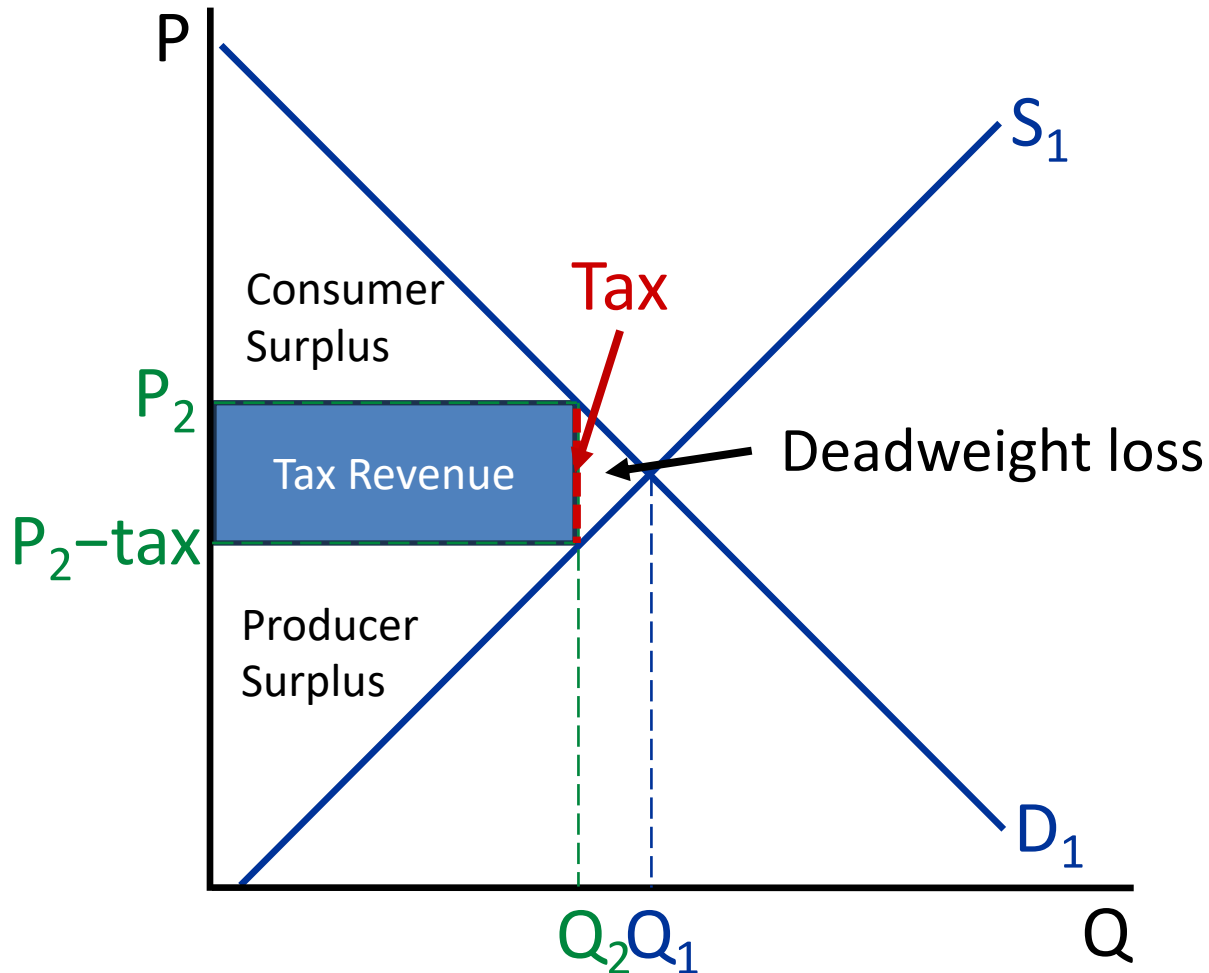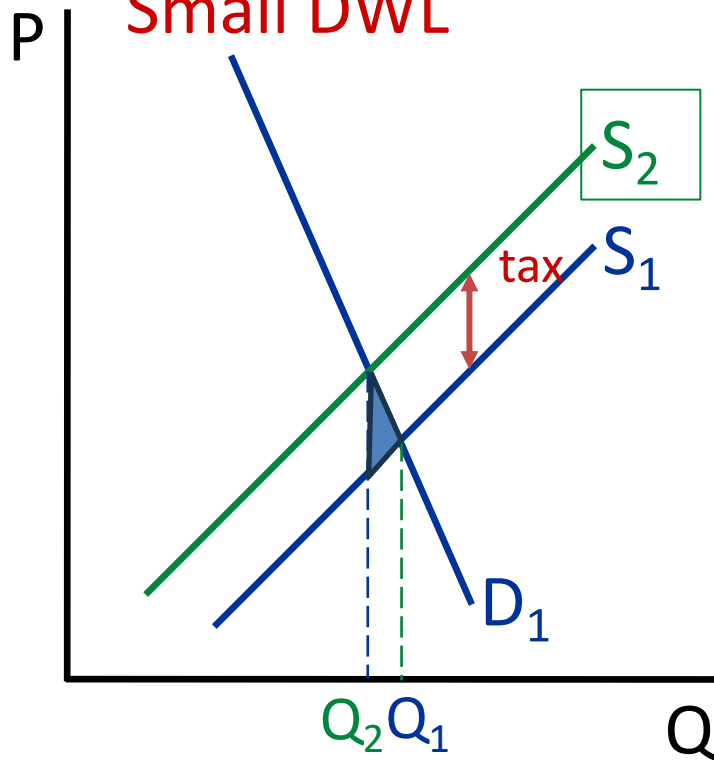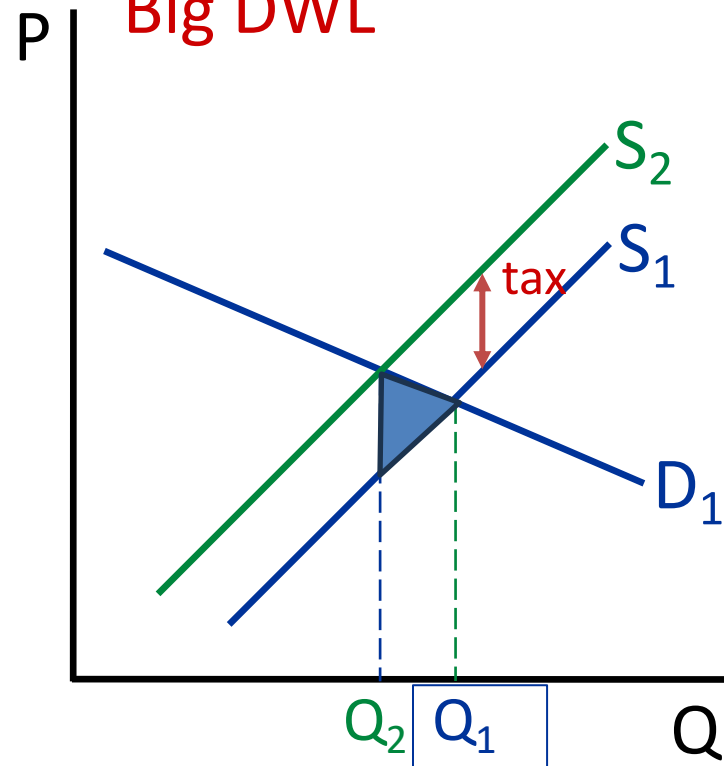
Some Points about the Welfare Effects of a Tax

- A tax extracts surplus from consumers and producers

- A tax distorts production below the competitive equilibrium and hence creates deadweight loss

- Production and consumption are still allocated according to willingness to pay and supply => no misallocation.

- Deadweight loss is larger when demand and/or supply are elastic. Taxing inelastic goods is more efficient.

- **Subsidy:** A subsidy distorts production above the competitive equilibrium, so at the resulting level of production and consumption MB<MC

Deadweight loss (DWL) bigger when supply and/or demand are elastic
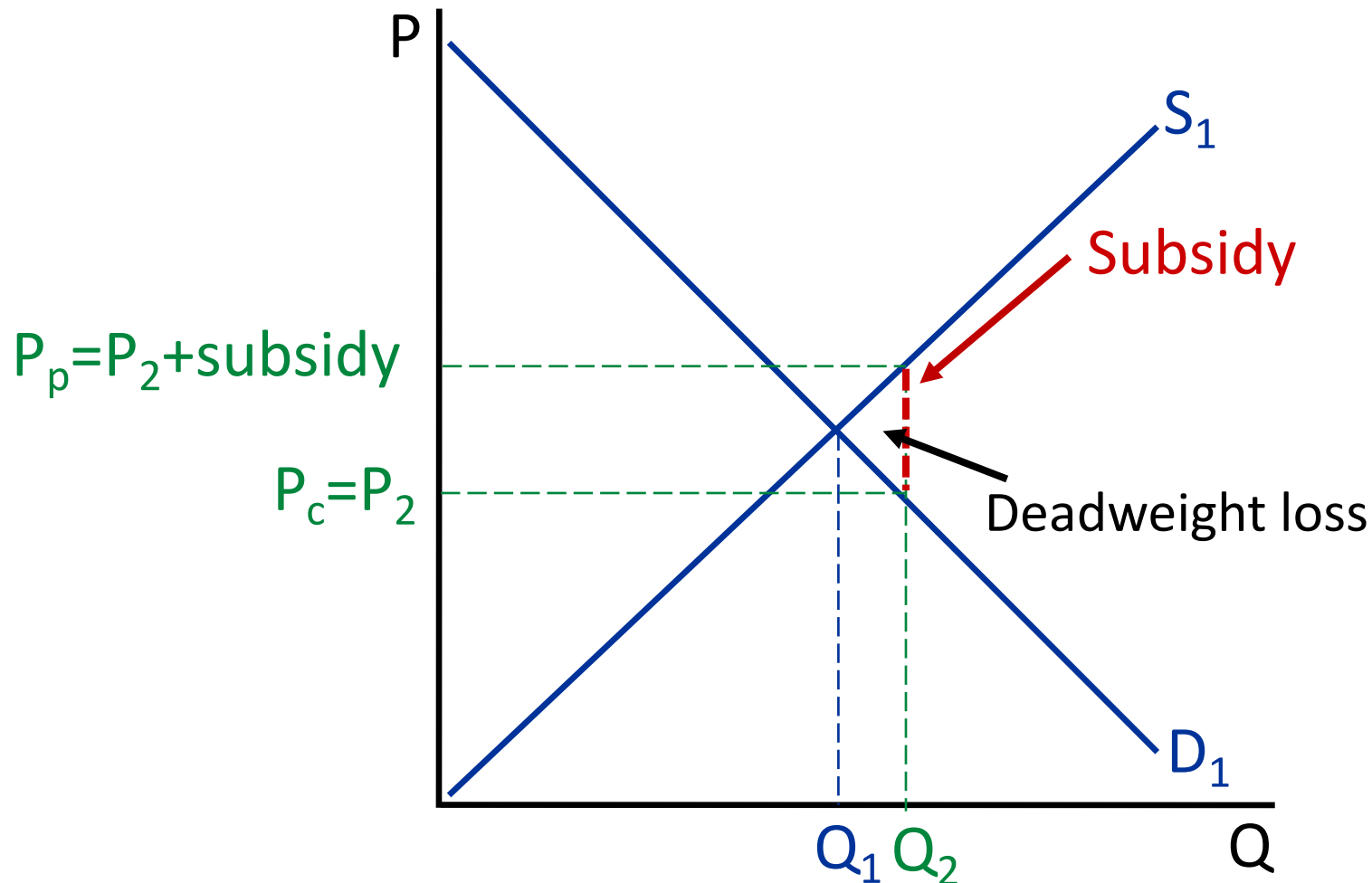
Inelastic demand: Small DWL

P

S_2

S_1

tax

D_1

Q_2 Q_1

Q

Elastic demand: Big DWL
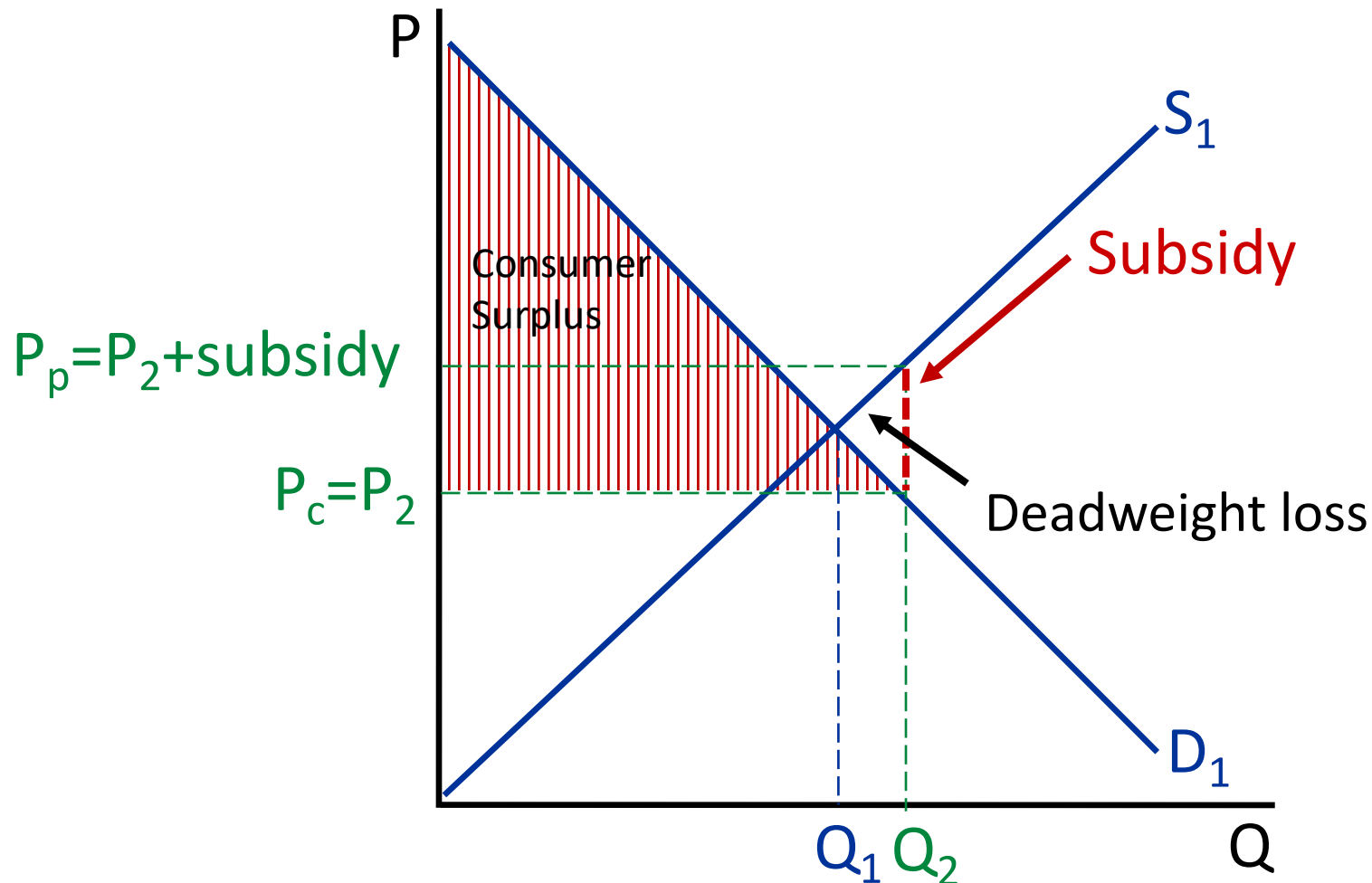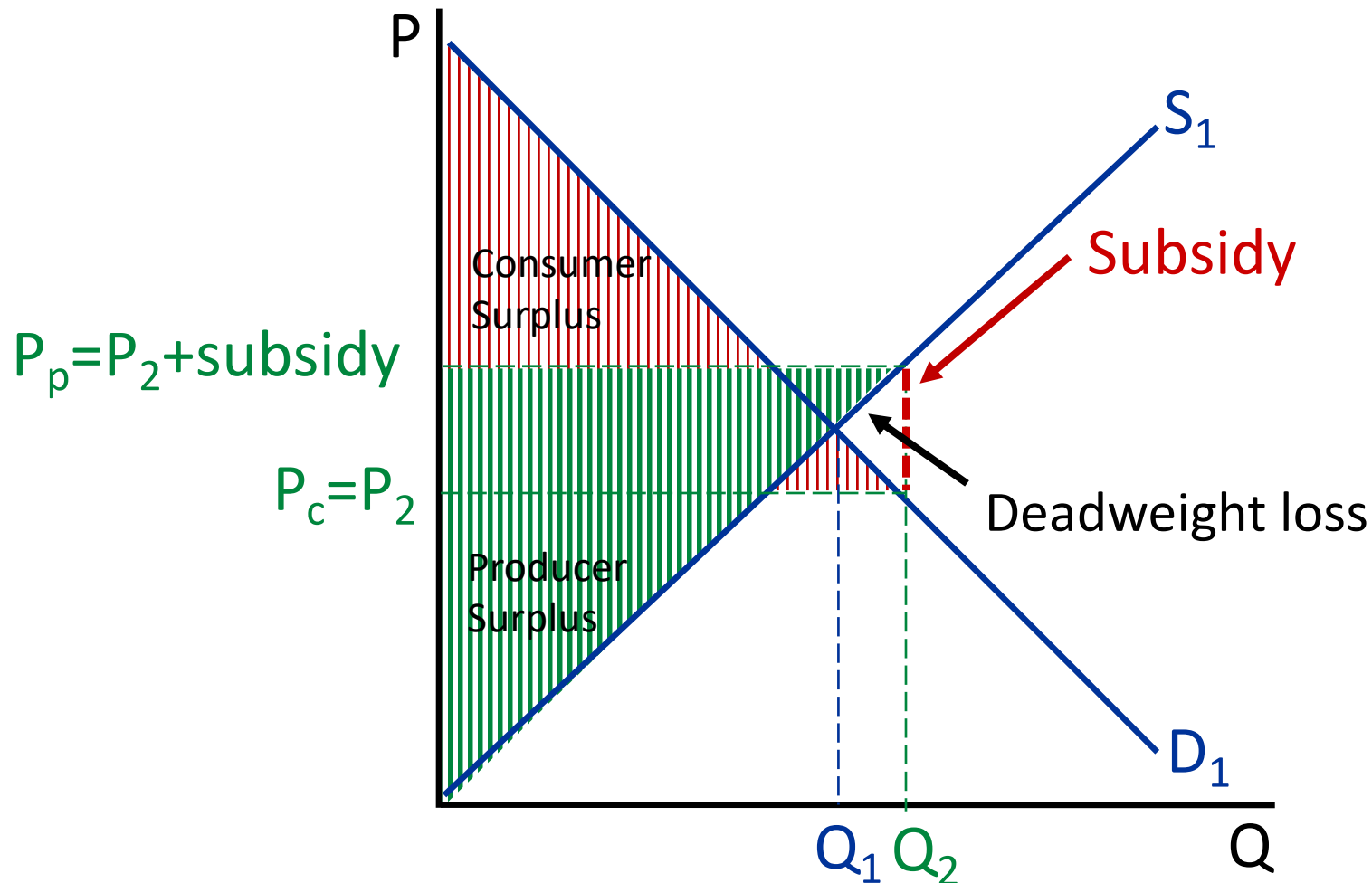
P

S_2

S_1

tax

D_1

Q_2 Q_1

Q

Welfare Analysis of a Subsidy:
Subsidy is like a negative tax and also creates deadweight loss

Welfare Analysis of a Subsidy:
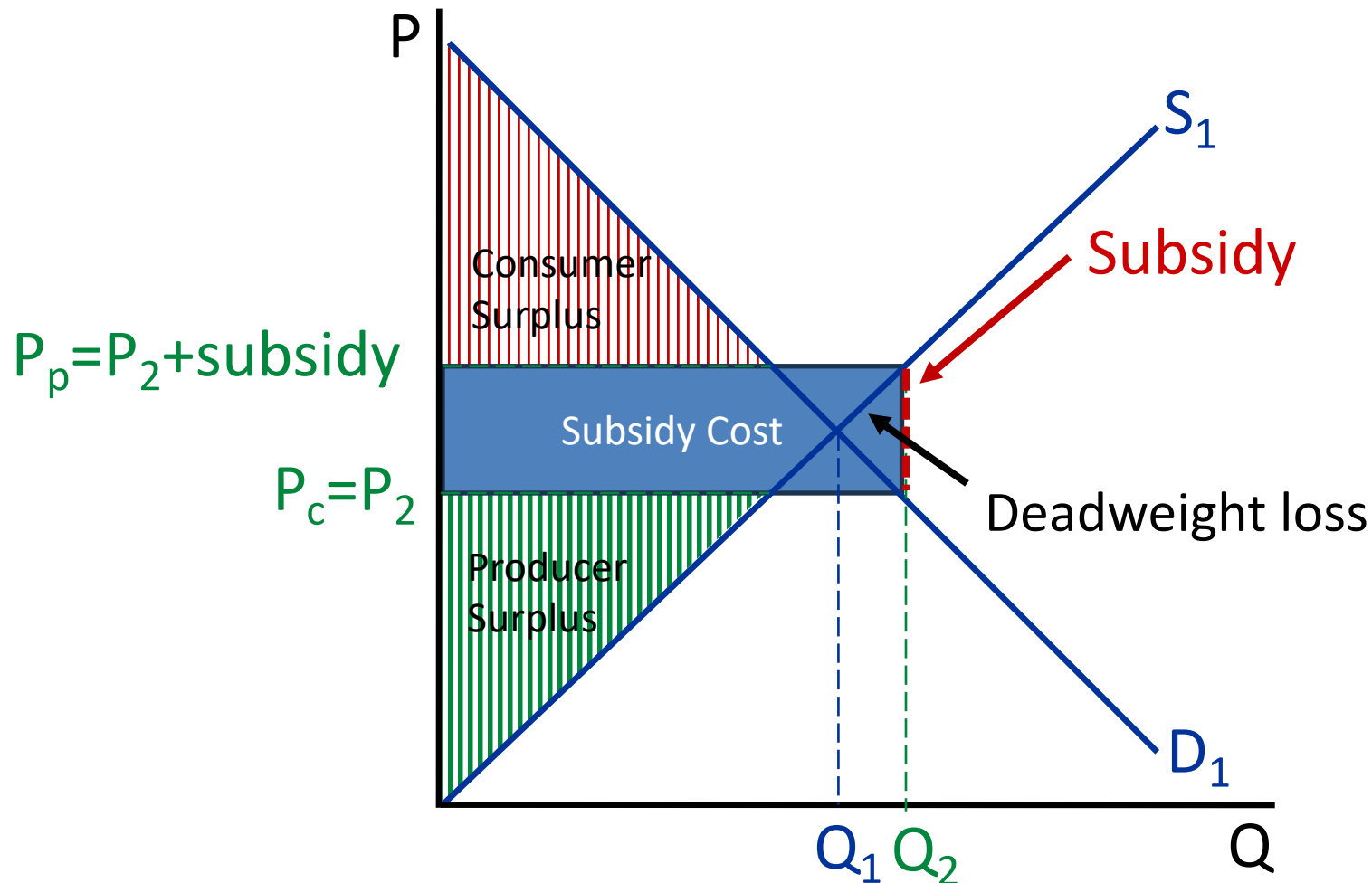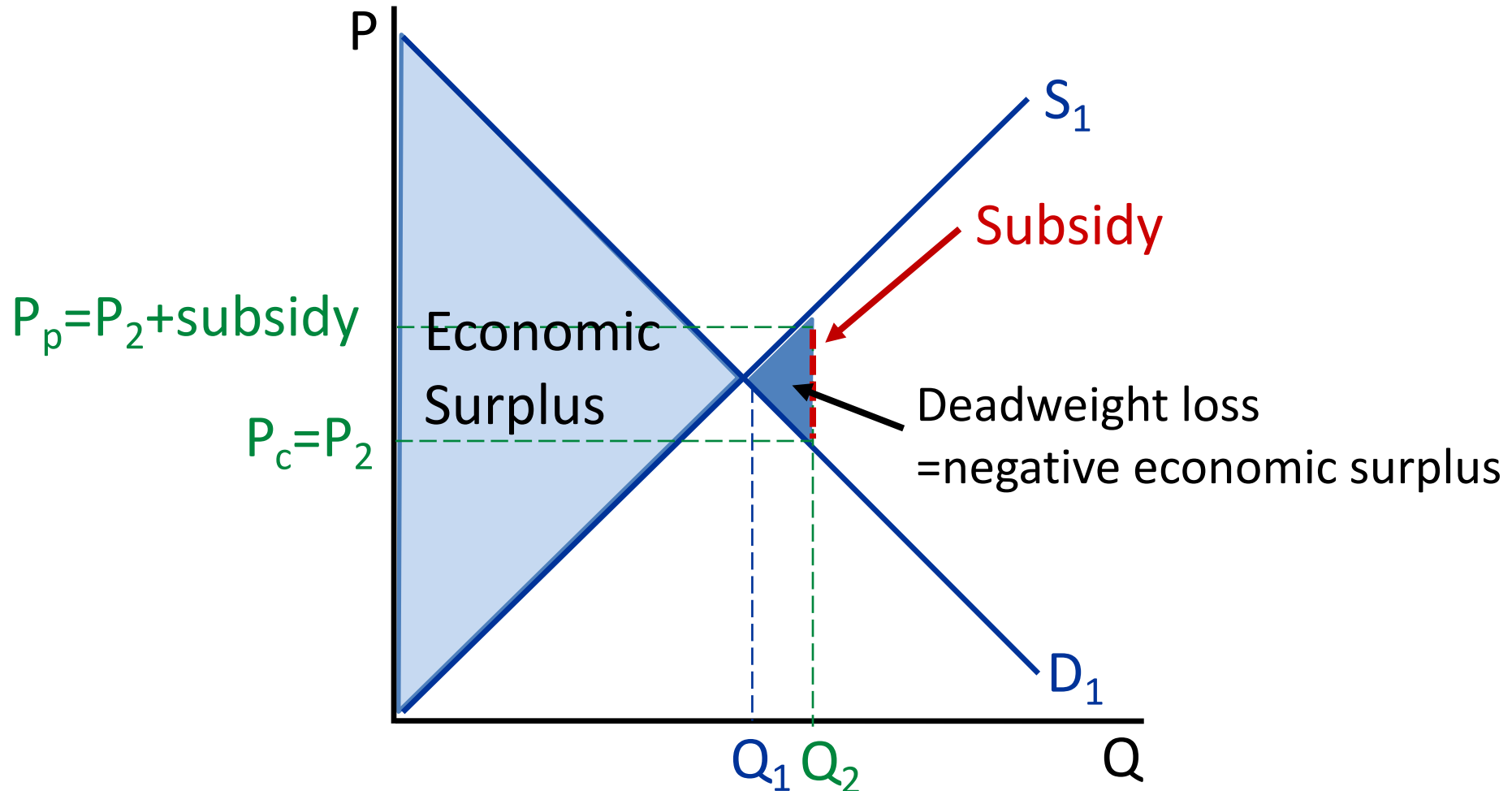## Subsidy is like a negative tax and also creates deadweight loss

Welfare Analysis of a Subsidy:
Subsidy is like a negative tax and also creates deadweight loss

Welfare Analysis of a Subsidy:
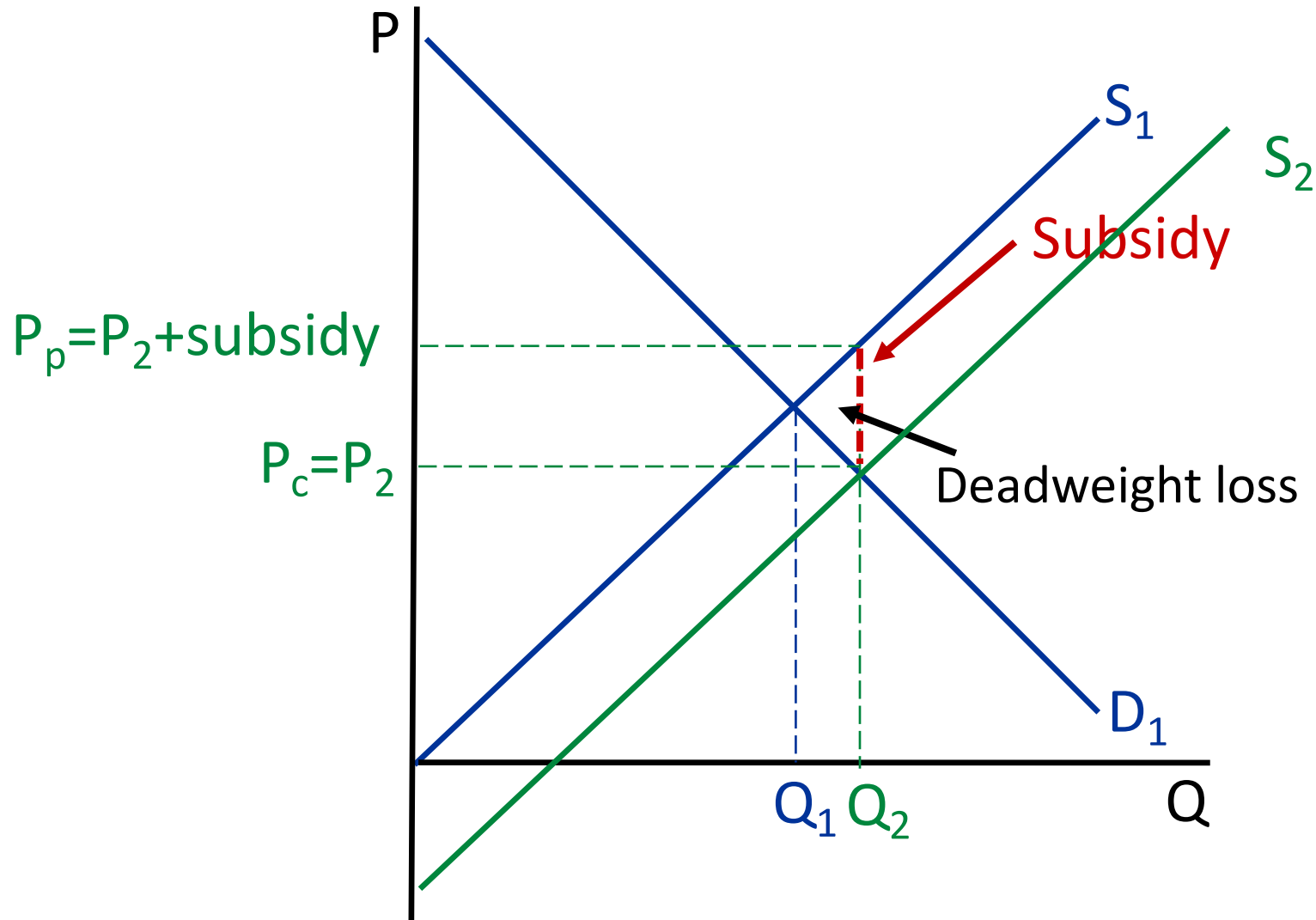## Subsidy is like a negative tax and also creates deadweight loss

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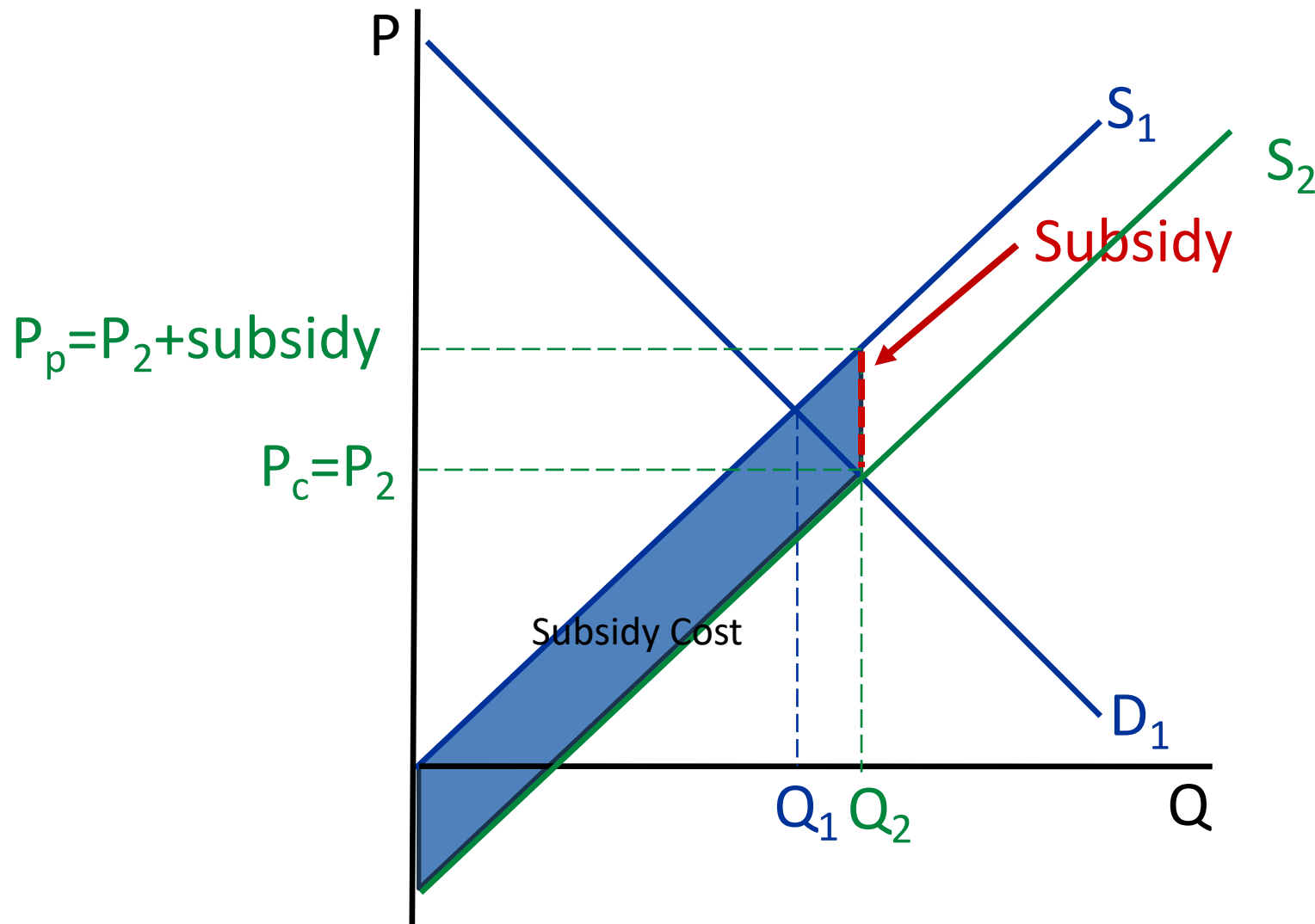## Subsidy is like a negative tax and also creates deadweight loss

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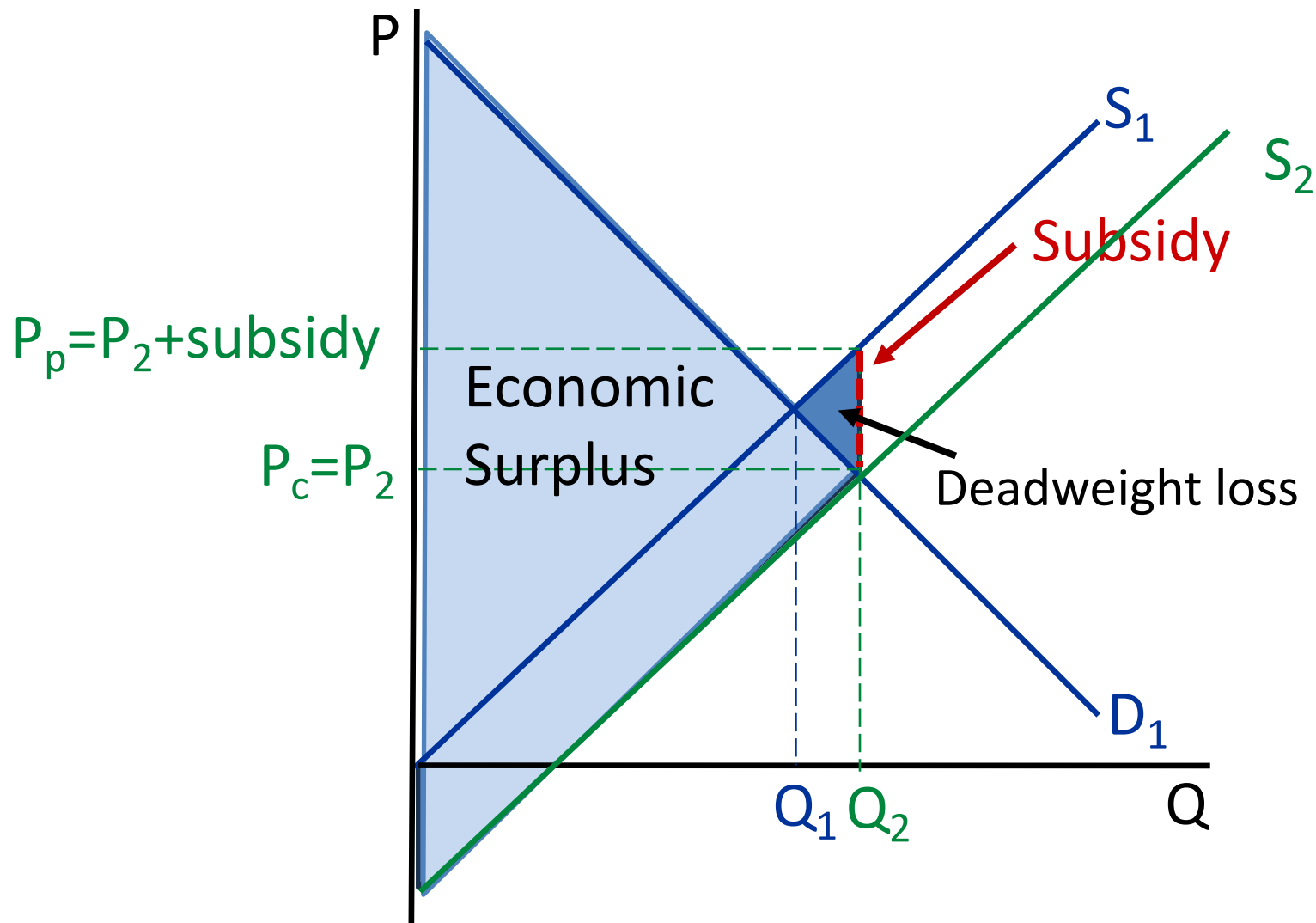
Welfare Analysis of a Subsidy:
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Welfare Analysis of a Subsidy:
Subsidy is like a negative tax and also creates deadweight loss
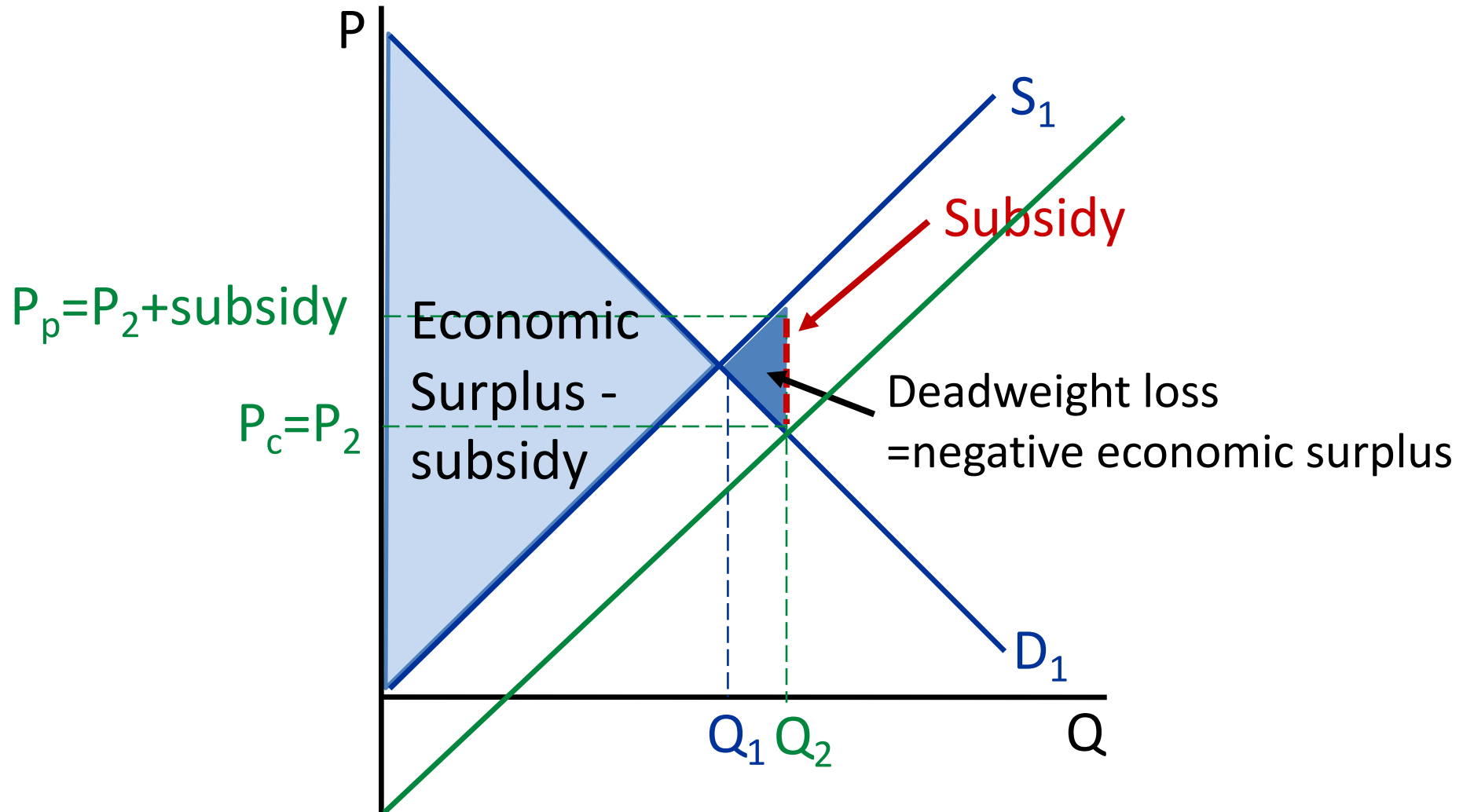
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