

Microeconomics II

The Analysis of Competitive Markets

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Paris Sciences et Lettres

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Interview to Mike Johnson (R) Speaker of the U.S. House of Representatives

- **Reporter:** Republican ran on lowering prices. What would you say if costs go up because of tariffs?
- **MJ:** I'm not gonna predict, um, the outcome, um -- first of all, which tariffs will be enacted and how it will affect prices we'll have to see



Introduction

- Can we actually predict how certain policies will affect prices and quantities?
- Can we make qualitative and quantitative statements about these policies?
- Who benefits? Who loses?
- Are markets always working fine?

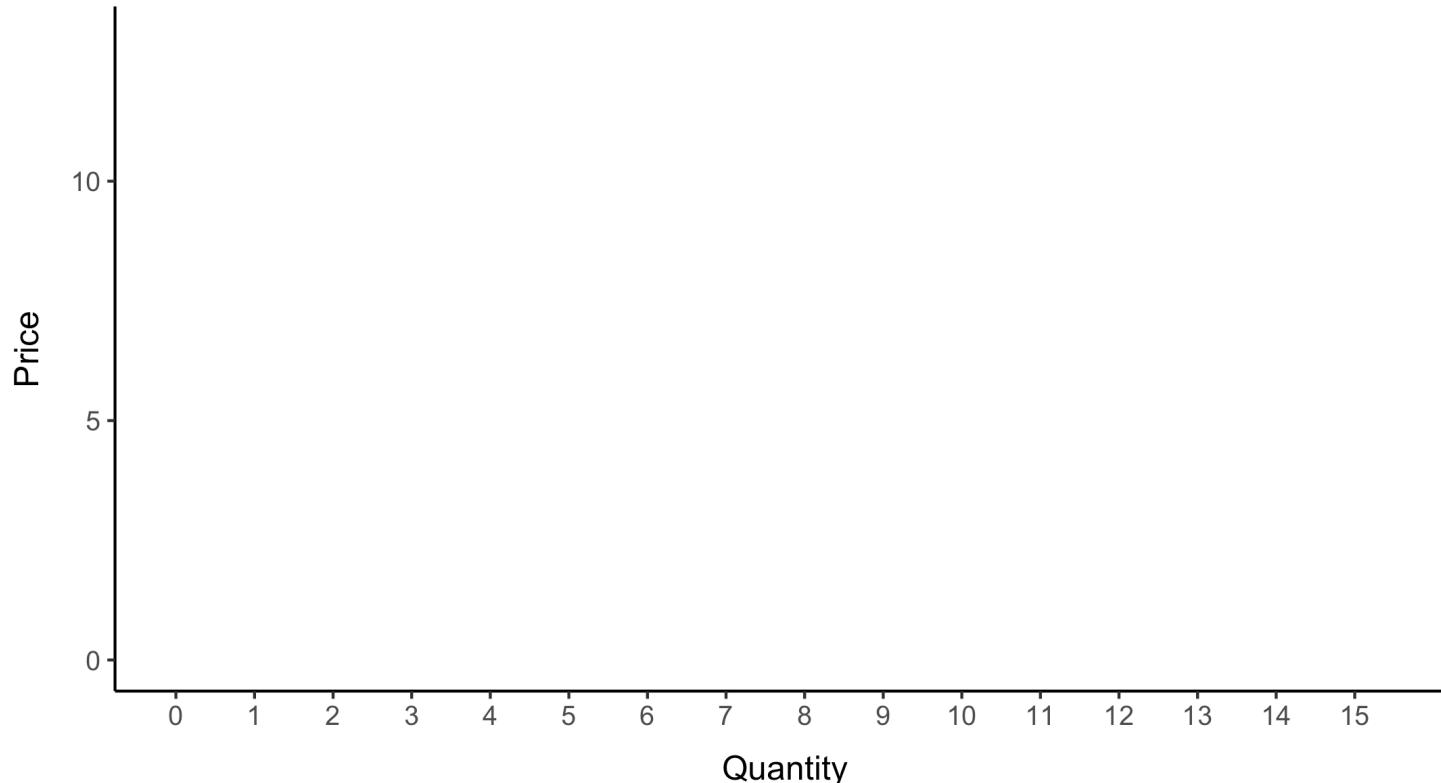
Evaluating the Gains and Losses from Government Policies— Consumer and Producer Surplus

Consumer and Producer Surplus

- In an unregulated, competitive market, consumers and producers buy and sell at the prevailing market price.

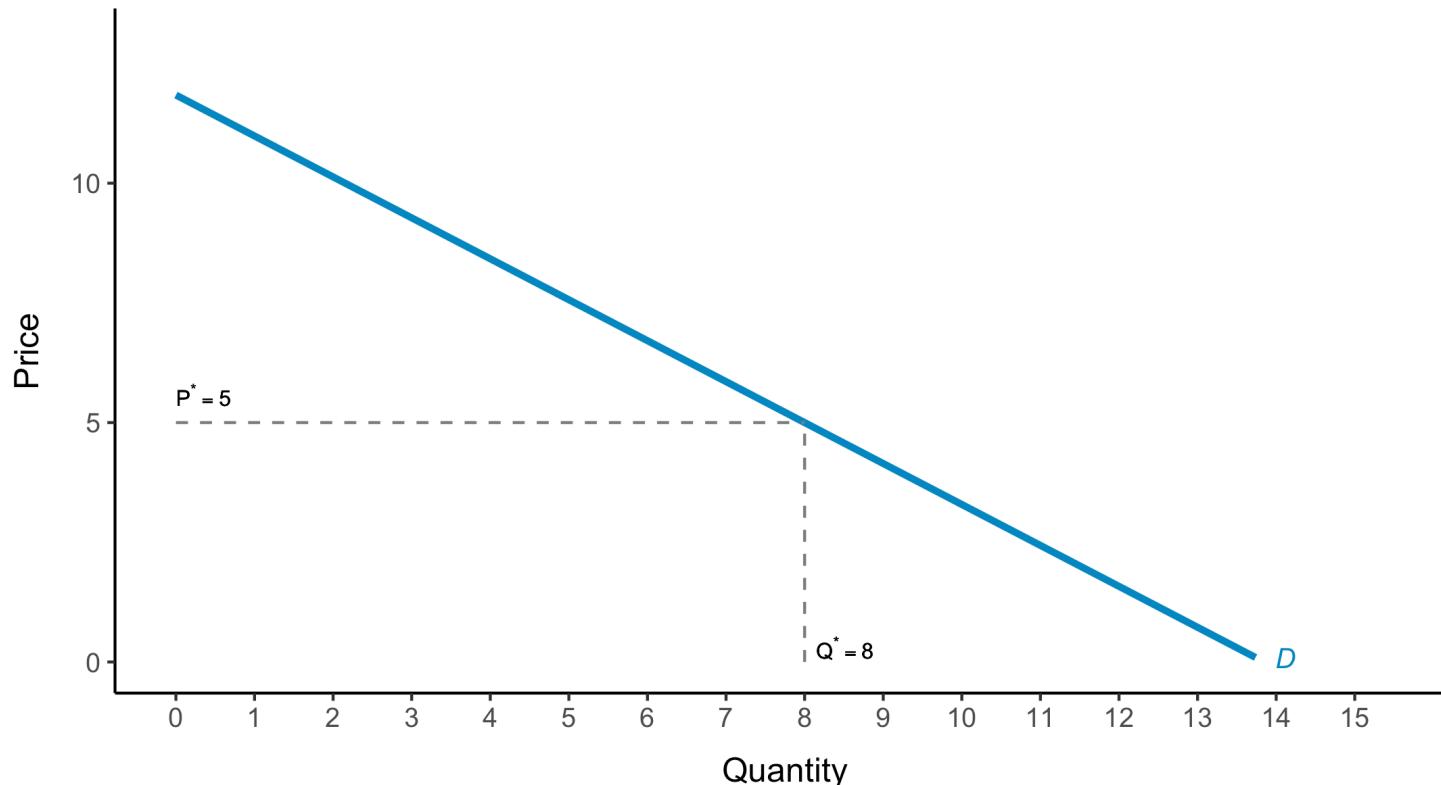
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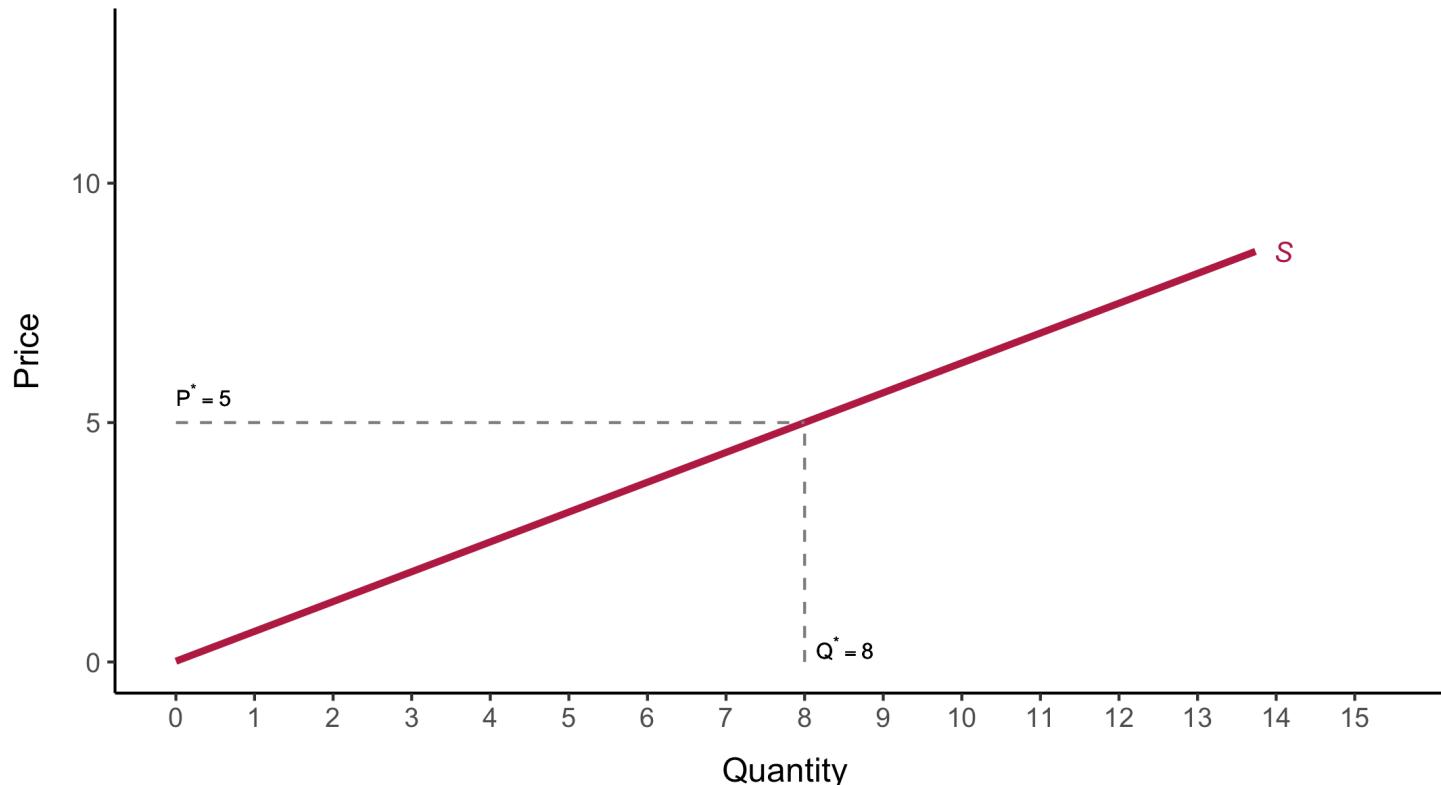
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$$Q_d = 11.8 - 0.855 \cdot P$$

Consumer and Producer Surplus

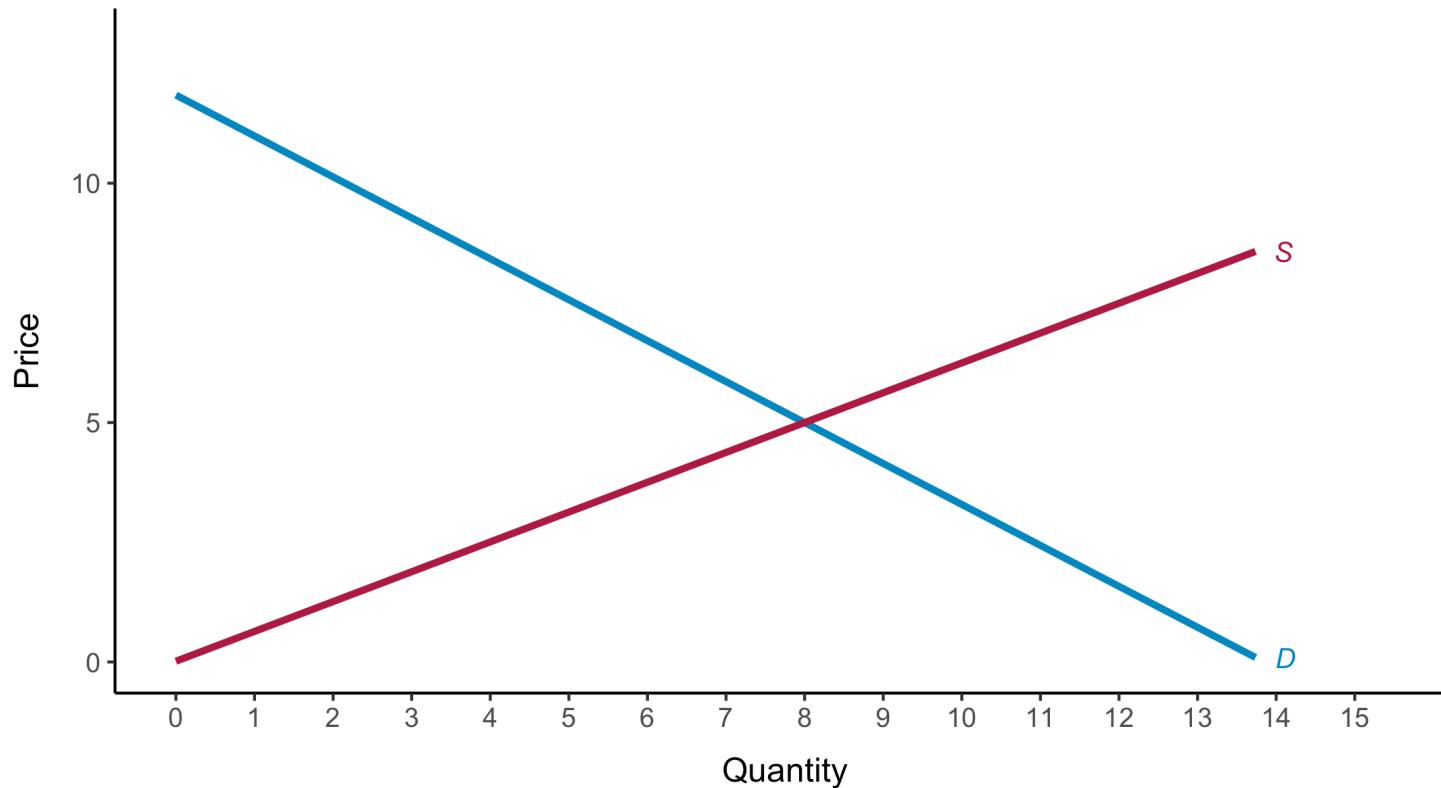
- In an unregulated, competitive market, consumers and producers buy and sell at the prevailing market price.



$$Q_s = 0.0155 + 0.623 \cdot P$$

Consumer and Producer Surplus

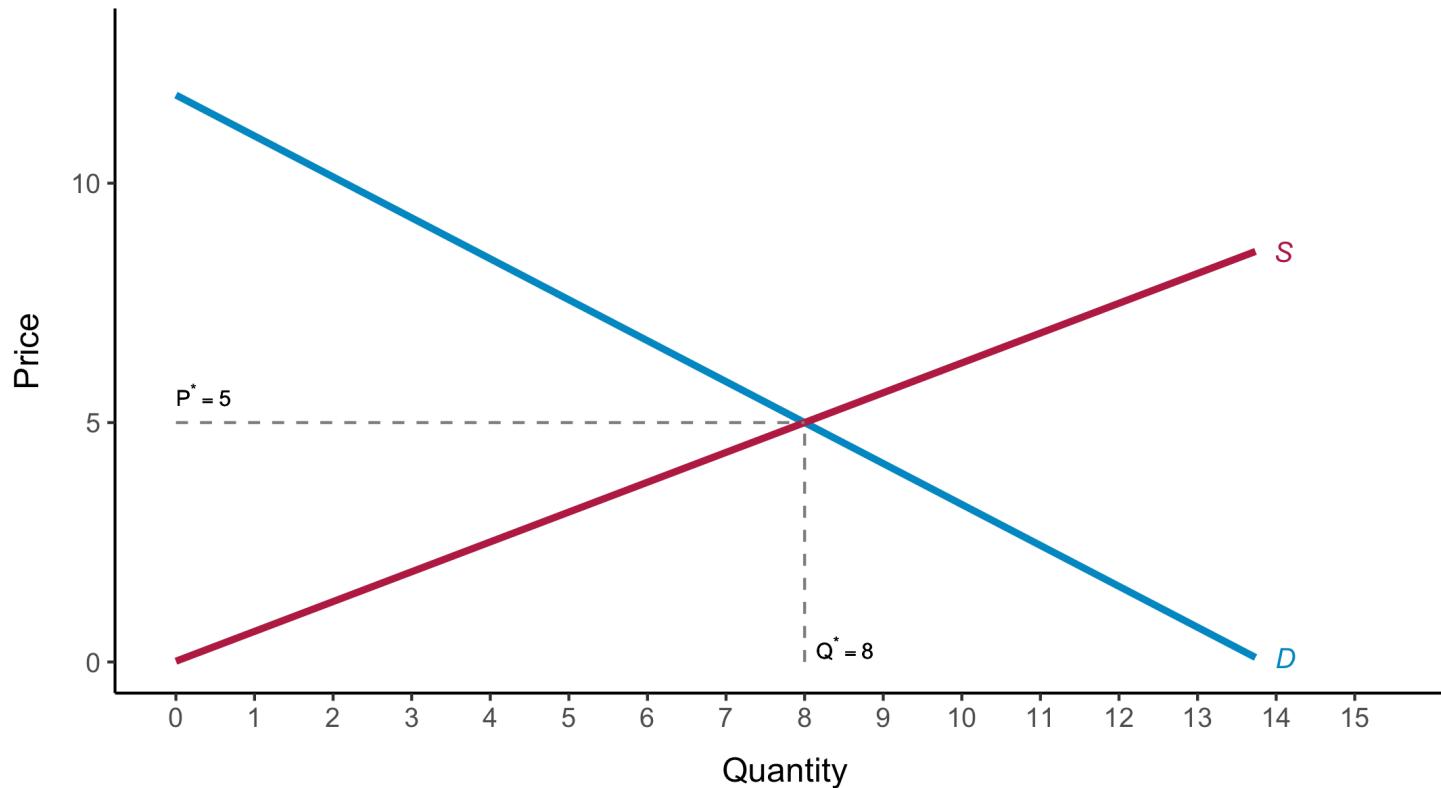
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Consumer and Producer Surplus

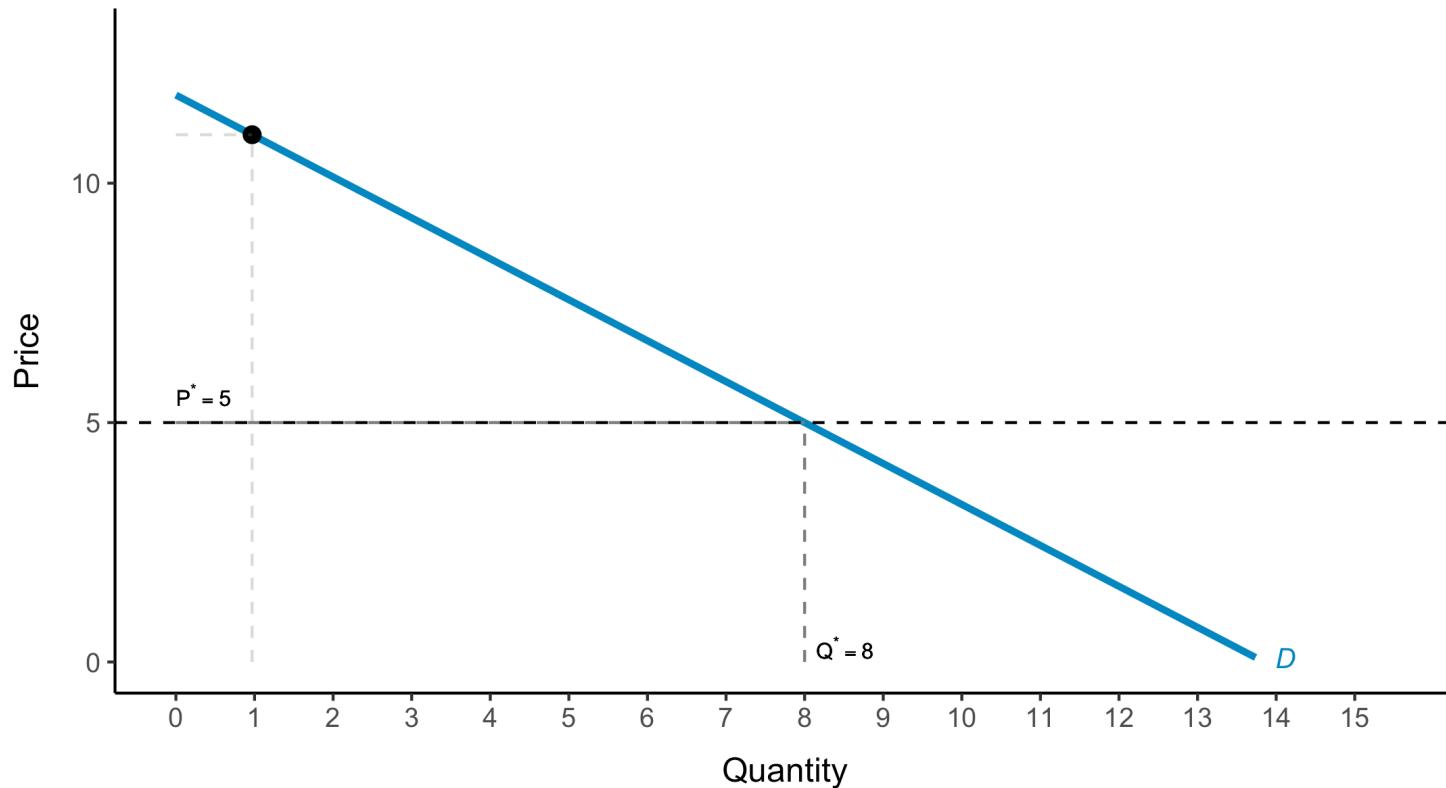
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$$Q^* = 8, P^* = 5$$

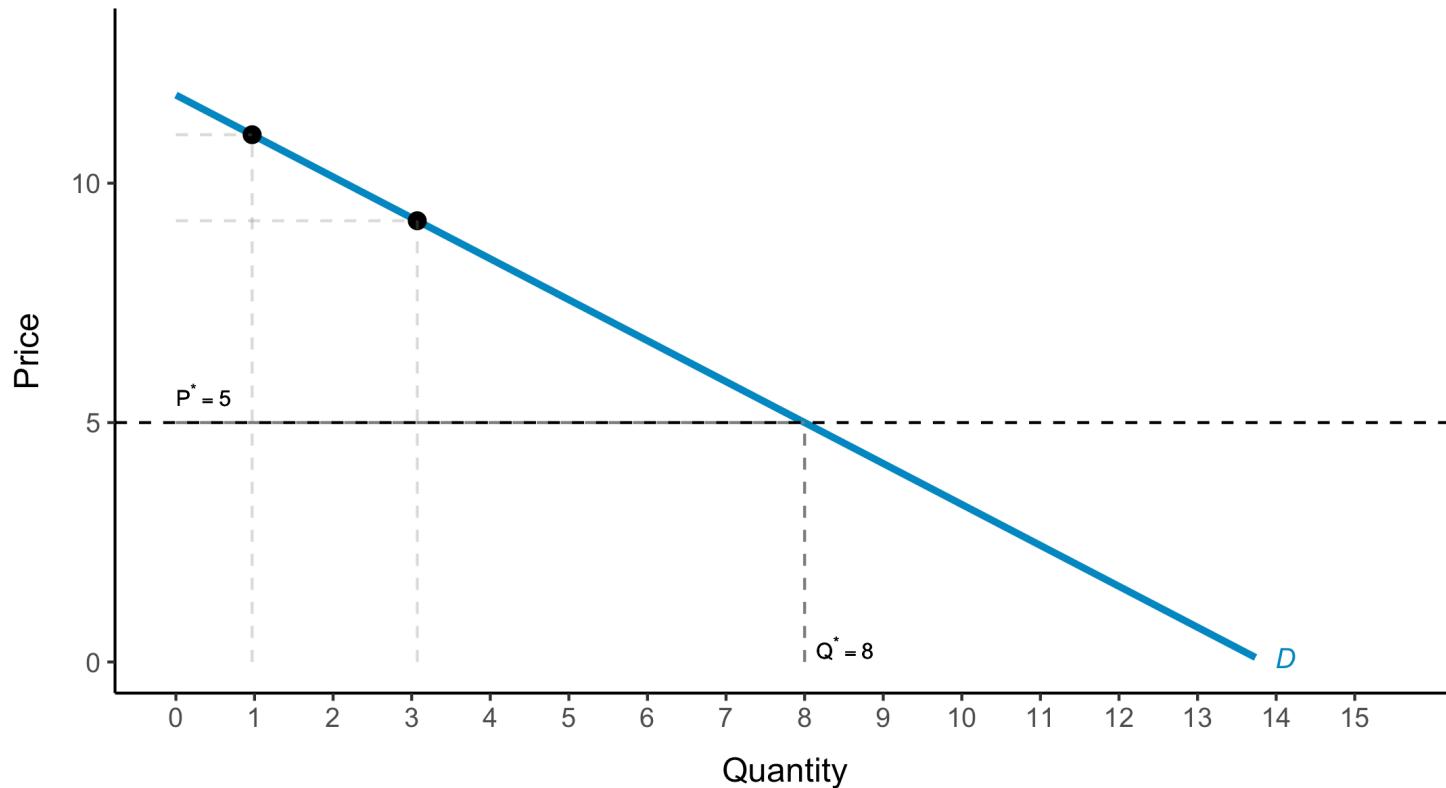
Consumer and Producer Surplus

- For each consumer i : $WTP_i \geq P$ or $WTP_i \leq P$



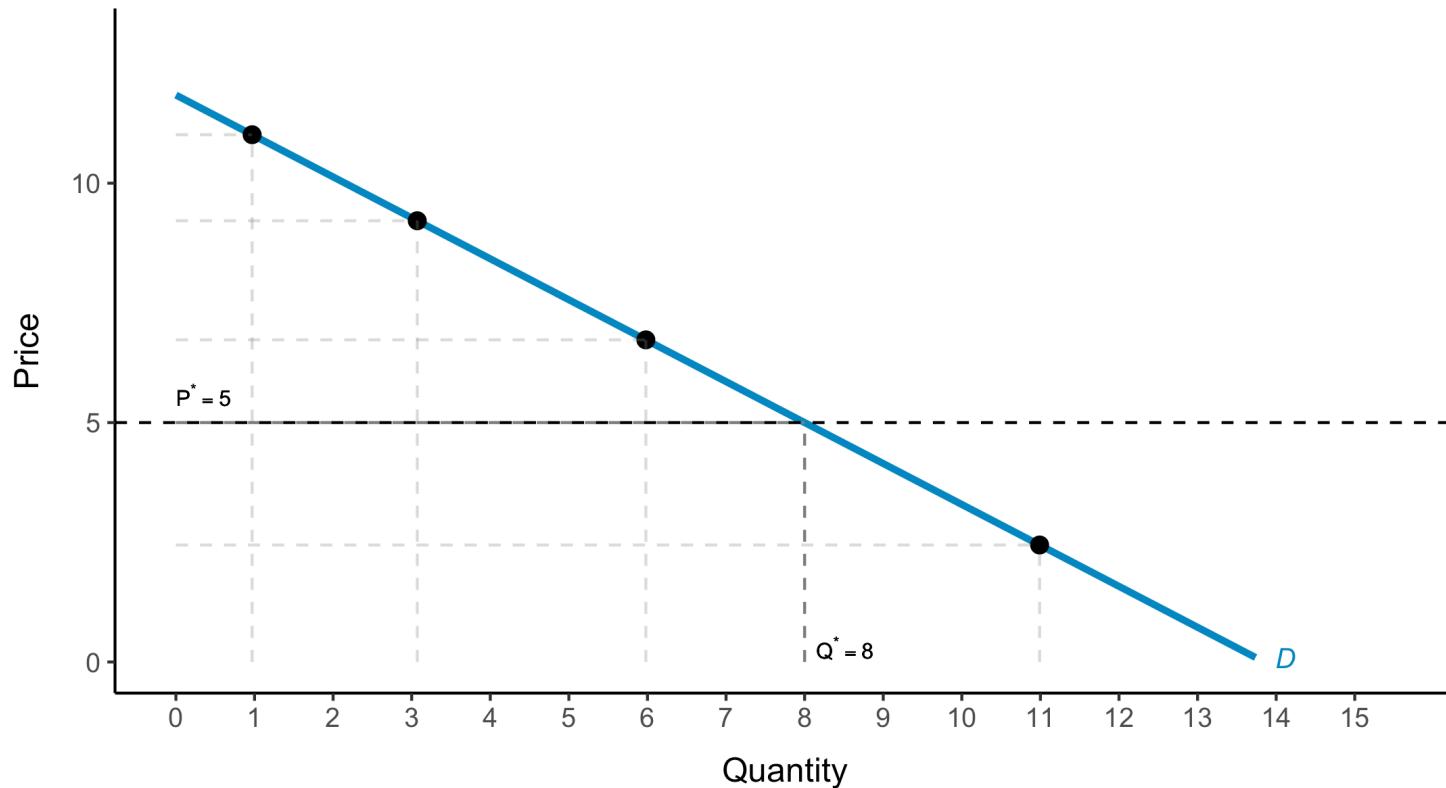
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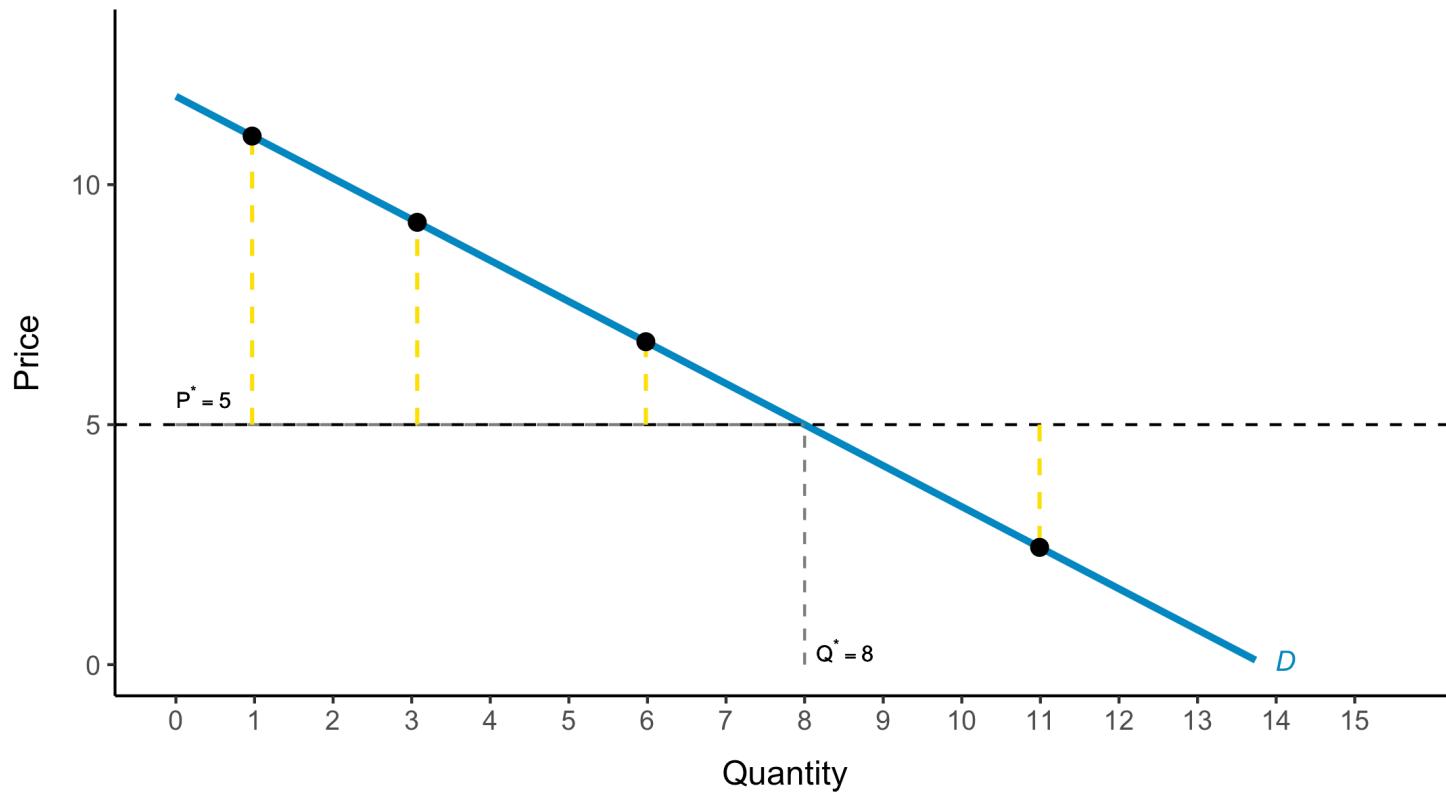
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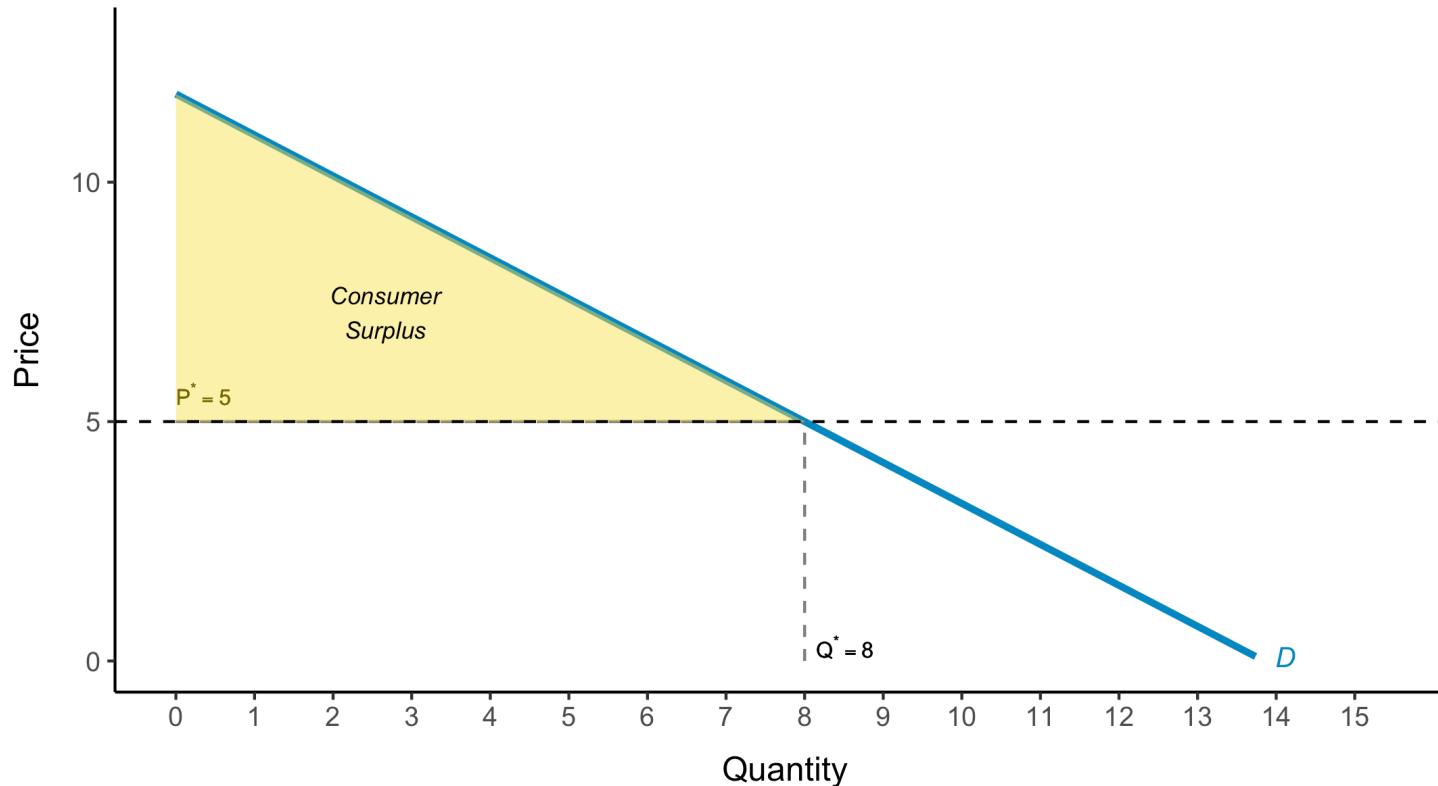
Consumer and Producer Surplus

- Net benefit to consumer i : $WTP_i - P$



Consumer and Producer Surplus

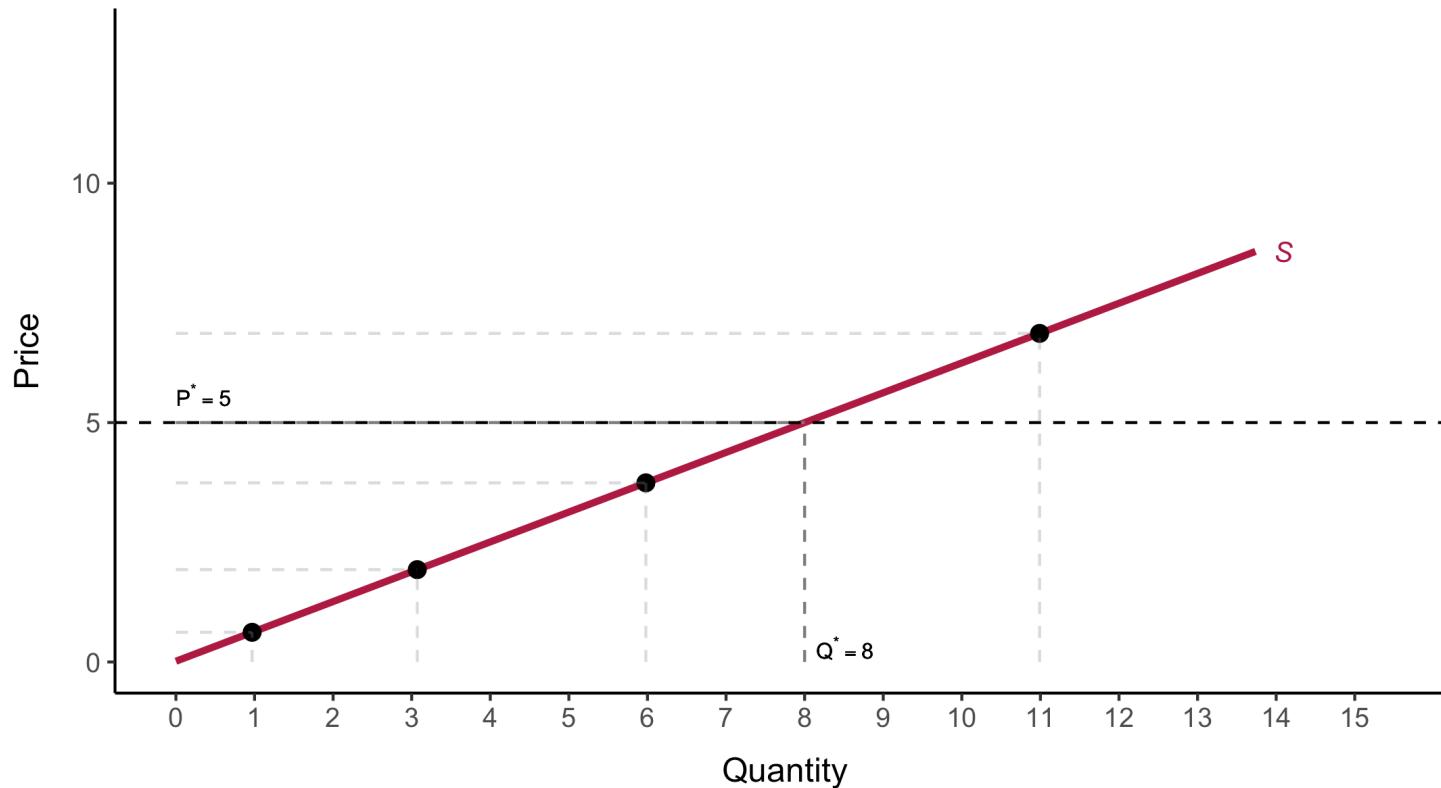
- **Consumer surplus:** total net benefit to consumers



$$\sum_i WTP_i - P \quad \forall WTP_i \geq P$$

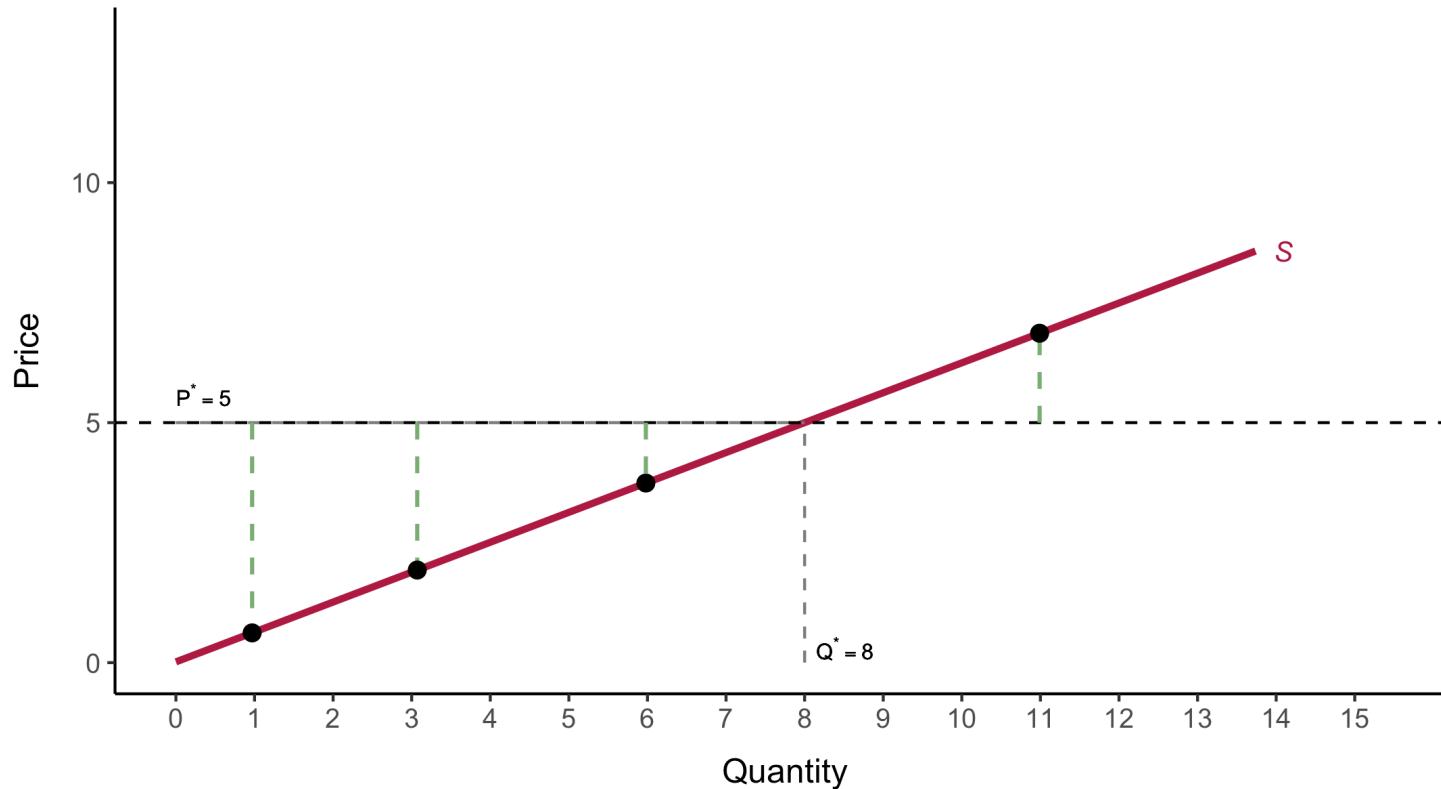
Consumer and Producer Surplus

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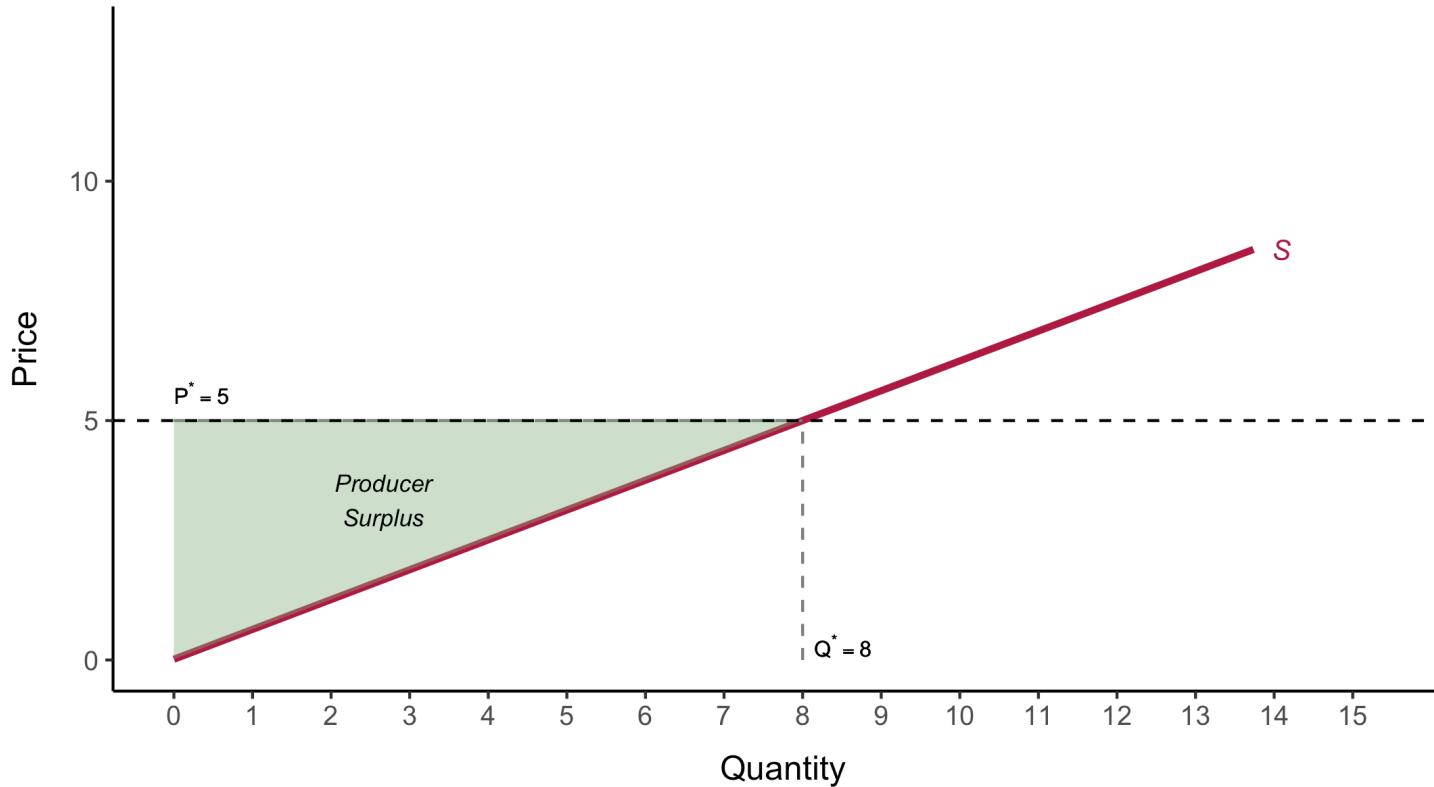
Consumer and Producer Surplus

- Net benefit to producer i : $P - WTS_i$



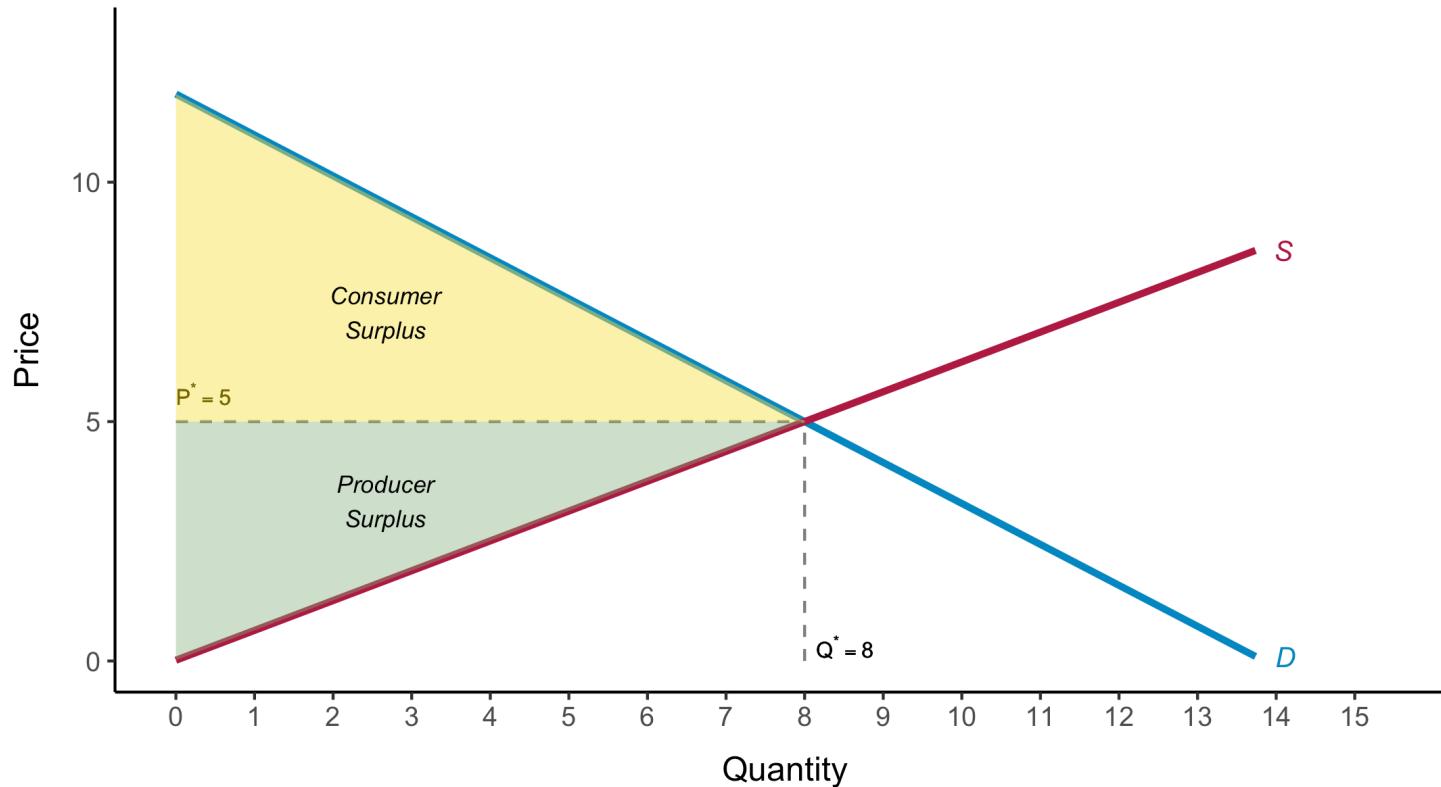
Consumer and Producer Surplus

- **Producer surplus:** the benefit that lower-cost producers enjoy by selling at the market price



$$\sum_i P - WTS_i \quad \forall WTS_i \leq P$$

Consumer and Producer Surplus



$$\text{Consumer surplus} \approx (8 \times (12 - 5))/2 = 28$$

$$\text{Producer surplus} \approx (8 \times (5))/2 = 20$$

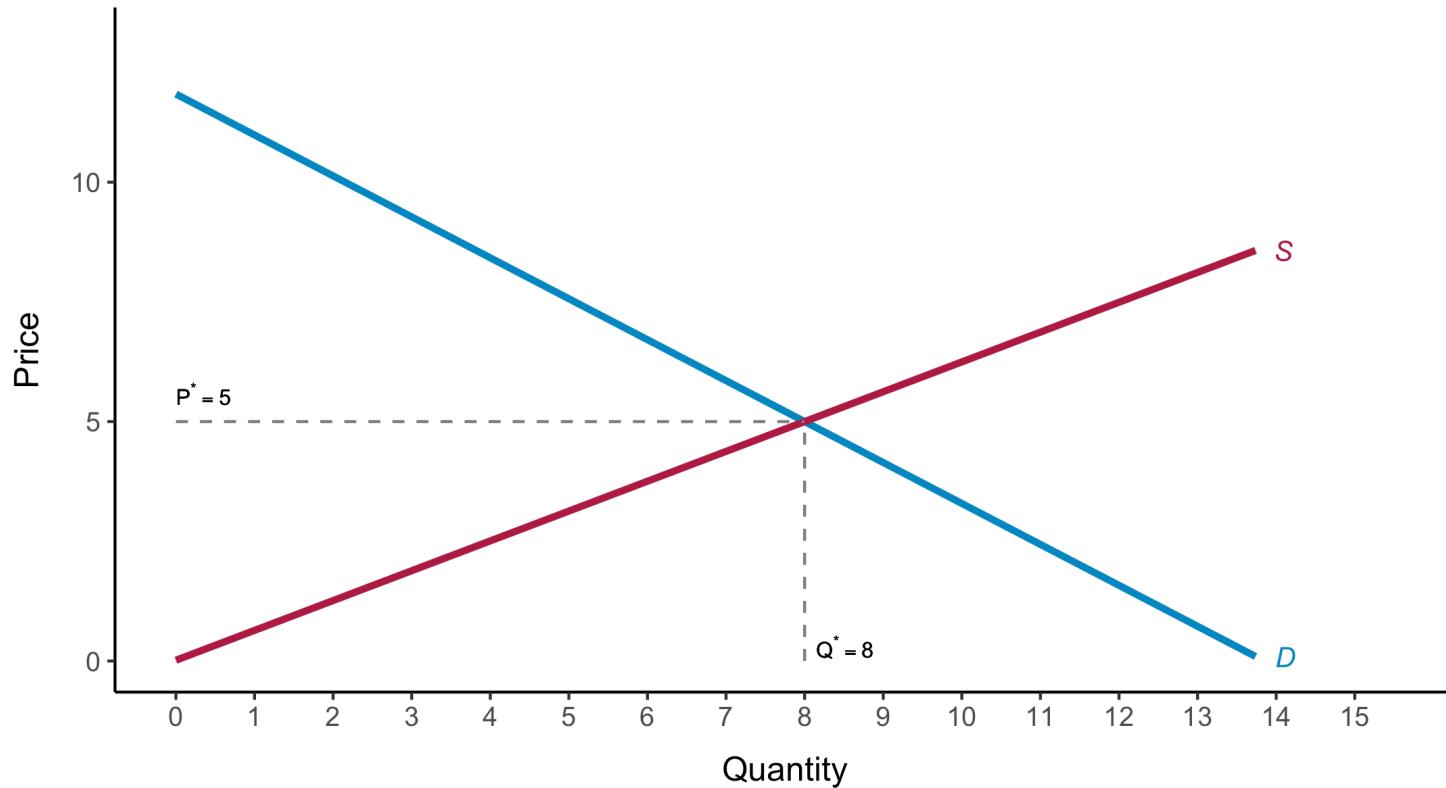
Welfare

Gains and losses to consumers and producers.

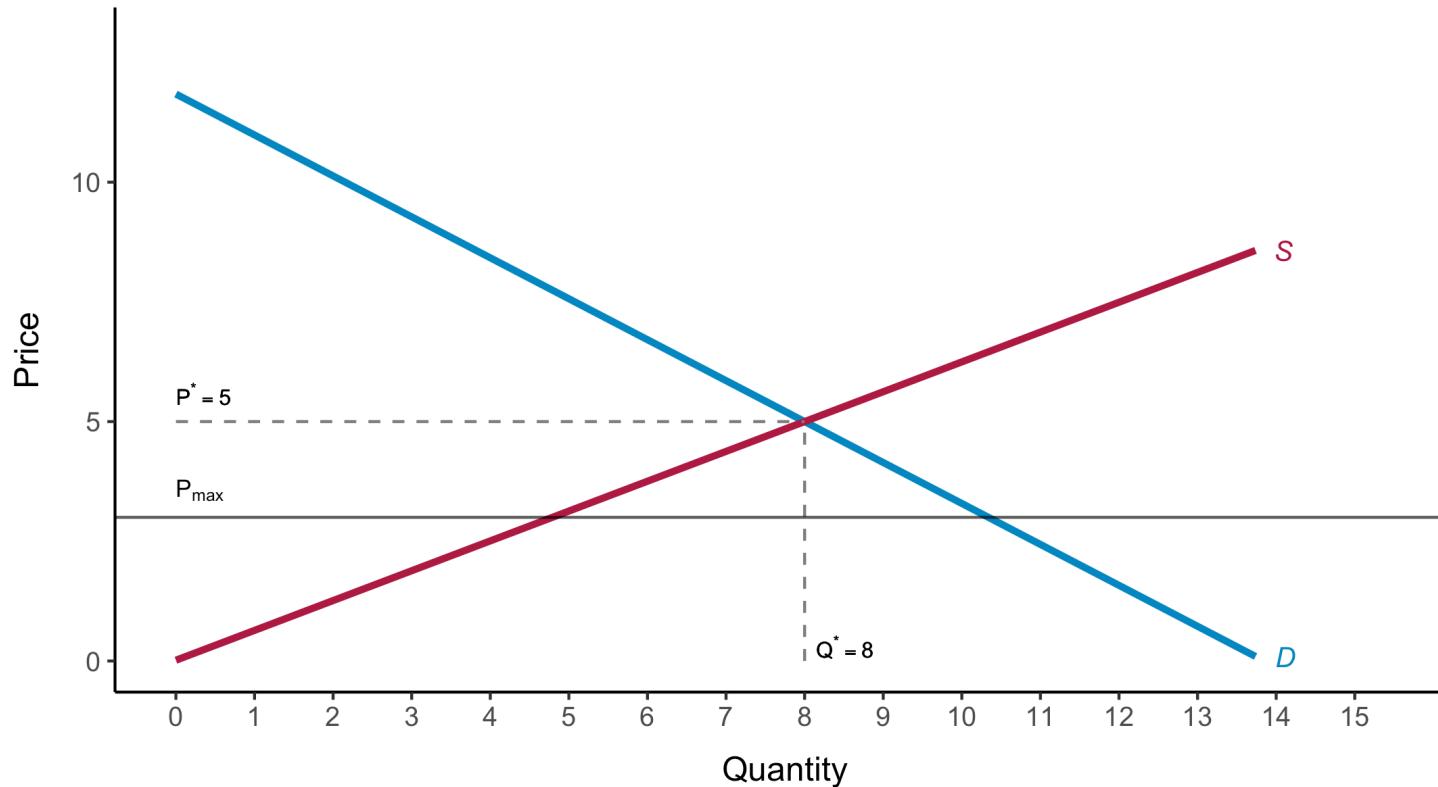
Together, consumer and producer surplus measure the welfare benefit of a competitive market.

Welfare allows us to evaluate quantitatively policies and market structures.

Welfare: Example - Price controls

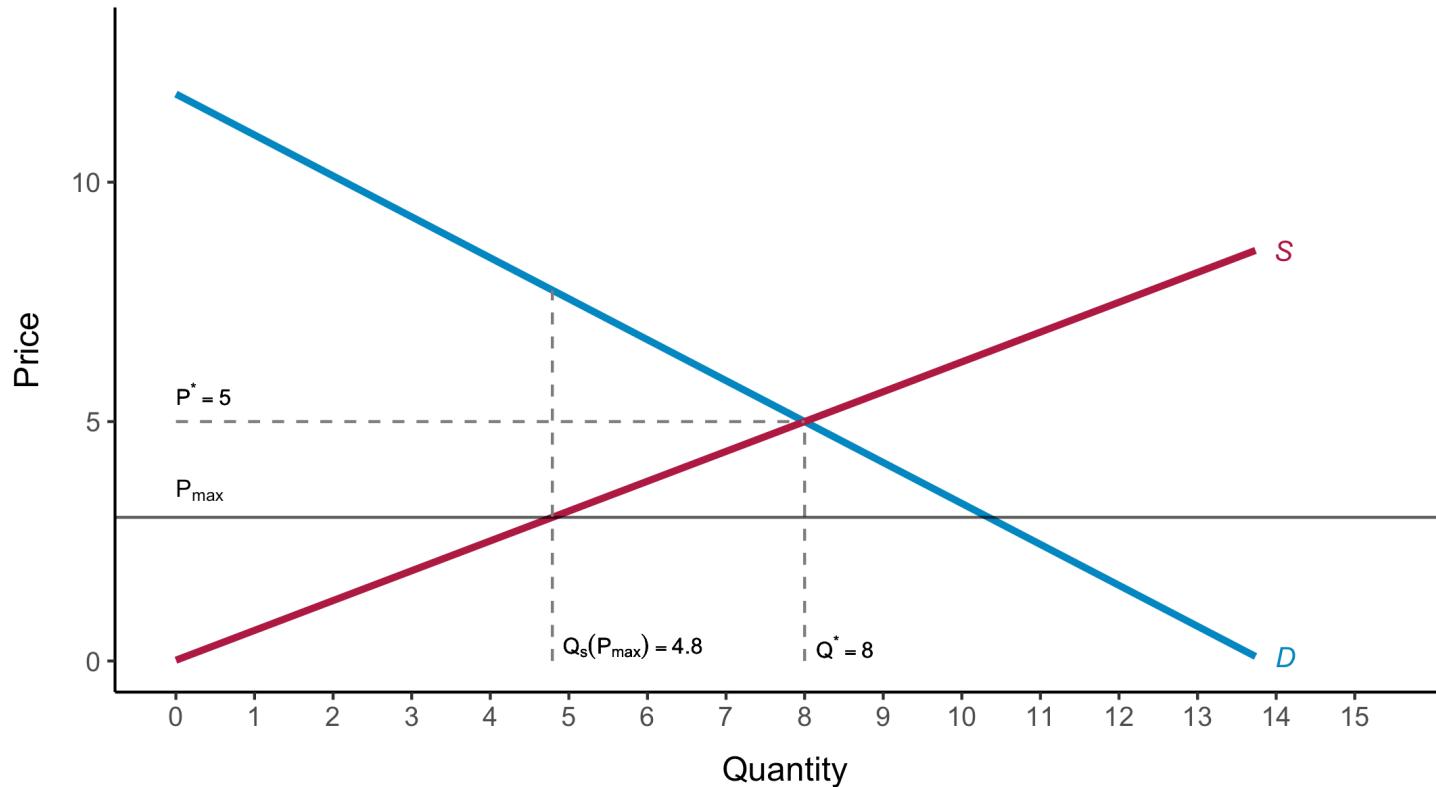


Welfare: Example - Price controls



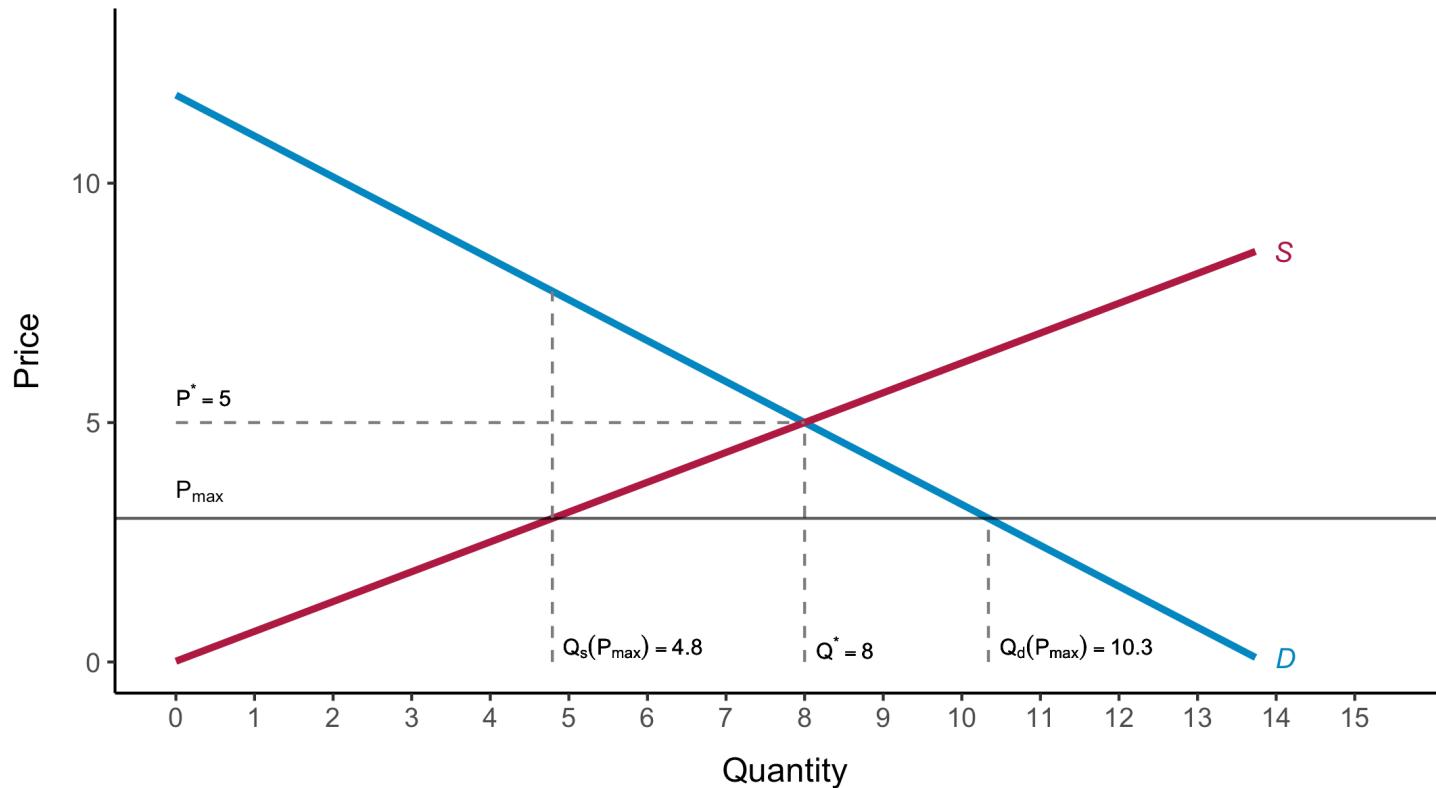
Price of a good has been regulated to be no higher than $P_{max} = 3$

Welfare: Example - Price controls



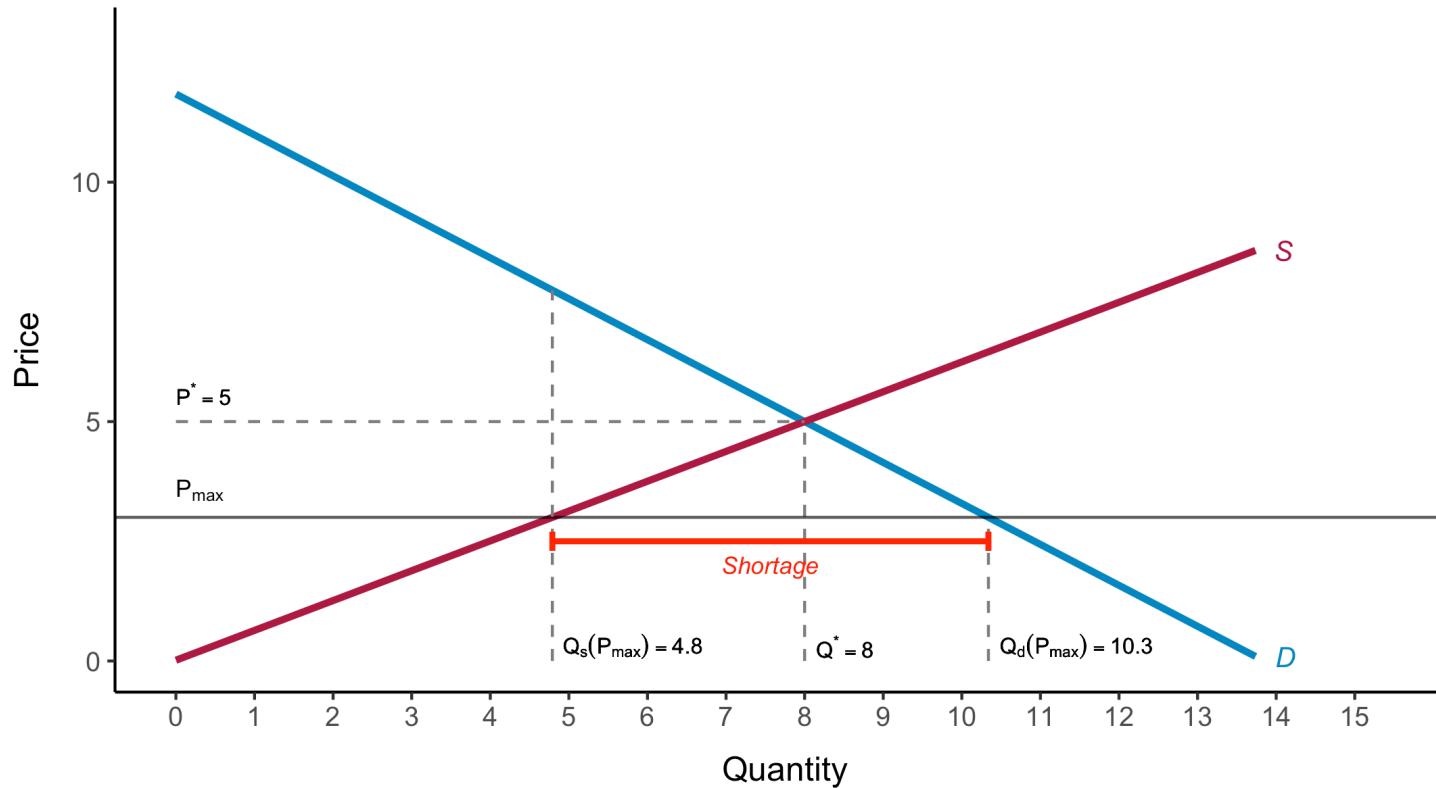
At $P_{max} = 3$, the supply equals ≈ 4.8

Welfare: Example - Price controls



At $P_{max} = 3$, the demand equals ≈ 10.3

Welfare: Example - Price controls



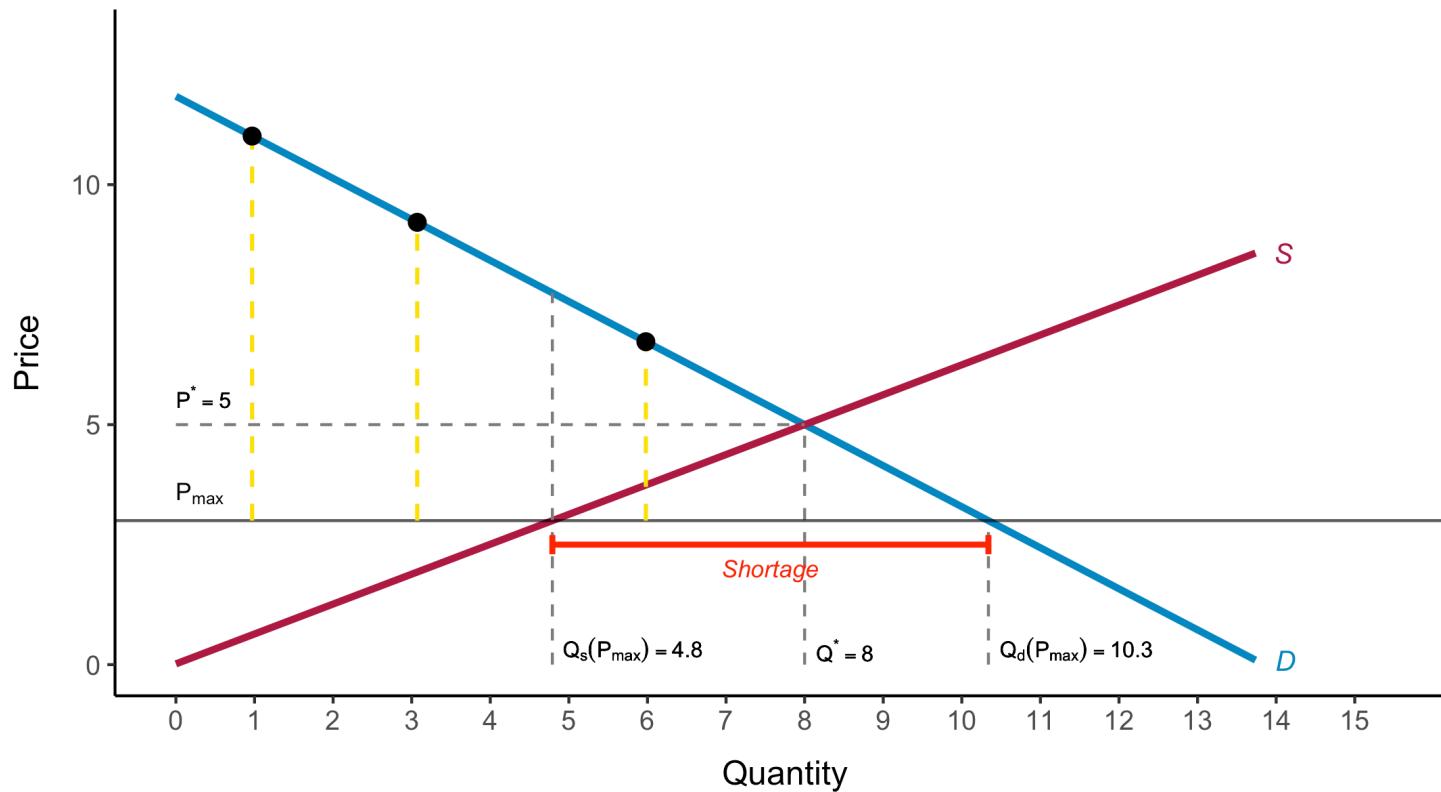
At $P_{max} = 3$, shortage or excess demand ≈ 5.5

Welfare: Example - Price controls

Change in Consumer Surplus: Some consumers are worse off as a result of the policy, and others are better off.

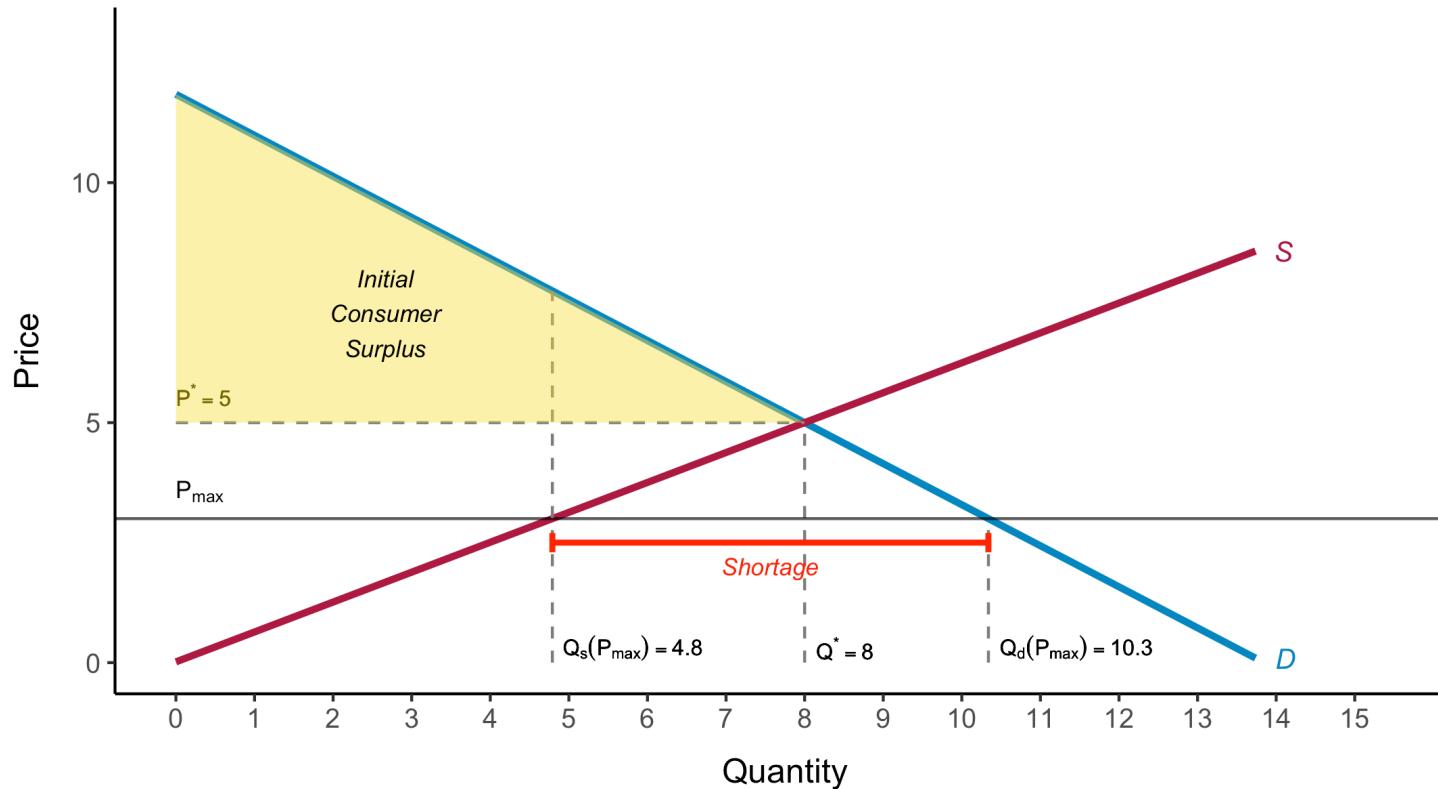
Welfare: Example - Price controls

Recall, net benefit to consumer i : $WTP_i - P_{max}$



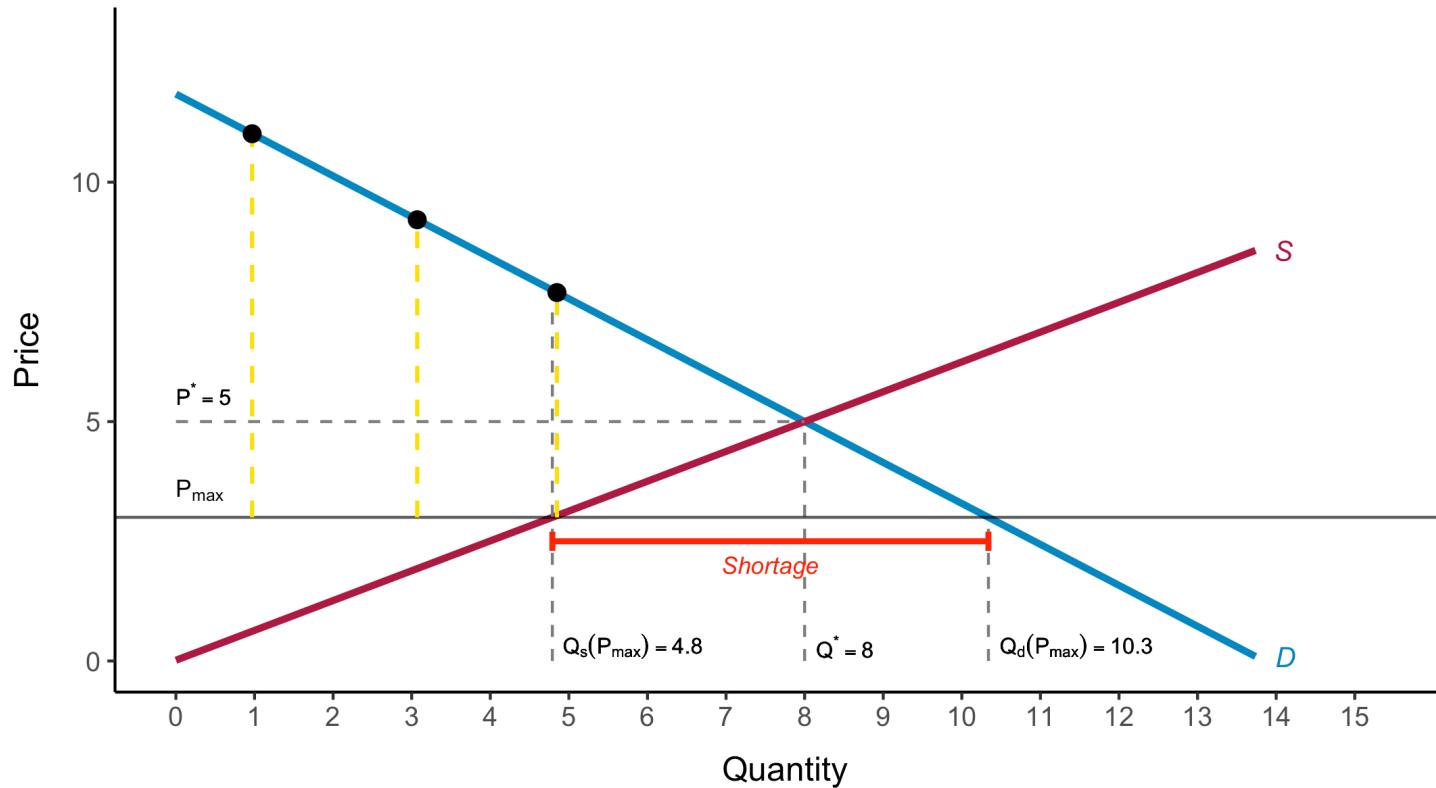
Welfare: Example - Price controls

Recall, net benefit to consumer i : $WTP_i - P_{max}$ and initial Consumer Surplus



Welfare: Example - Price controls

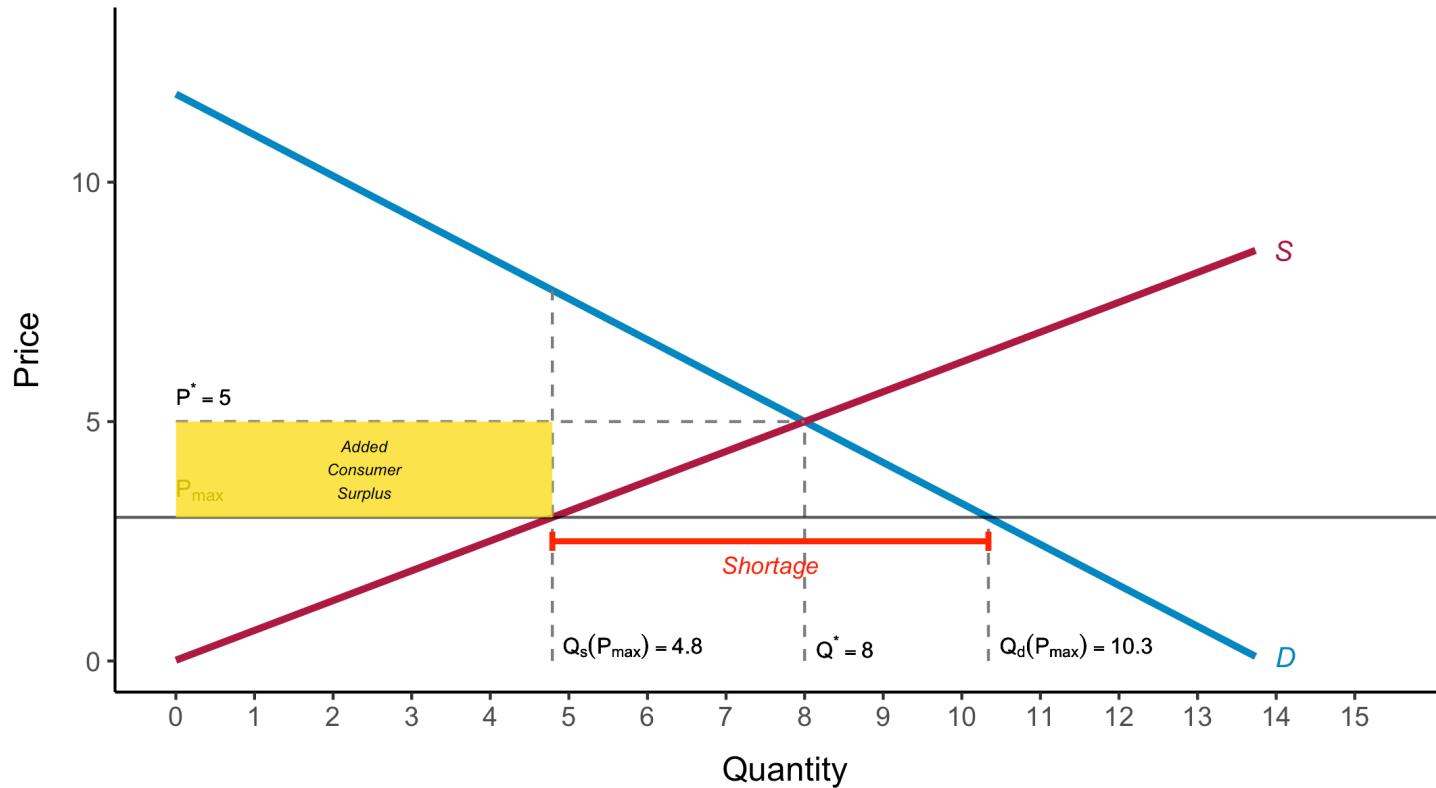
Change in Consumer Surplus



- Better off: purchase the good (they are lucky or are willing to wait in line)

Welfare: Example - Price controls

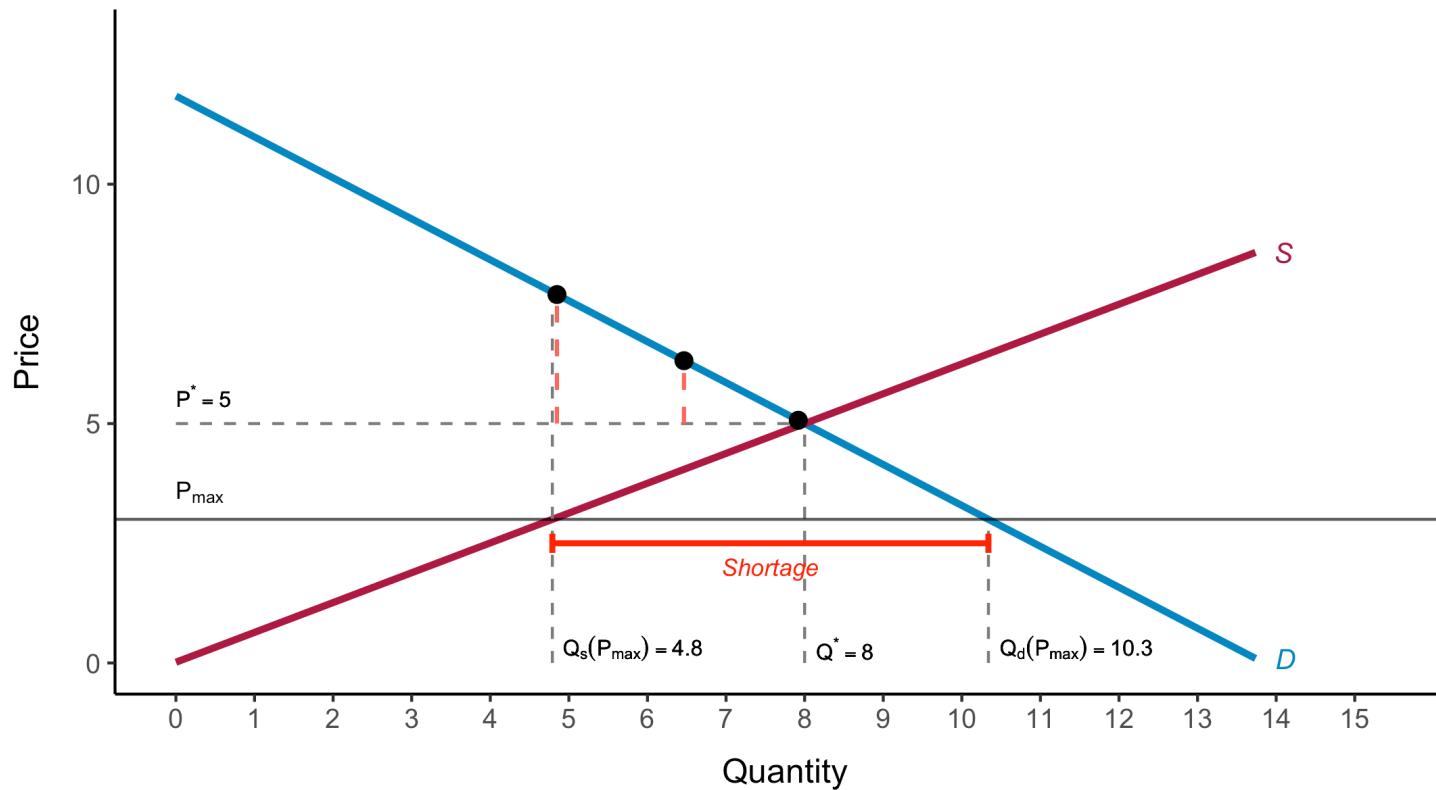
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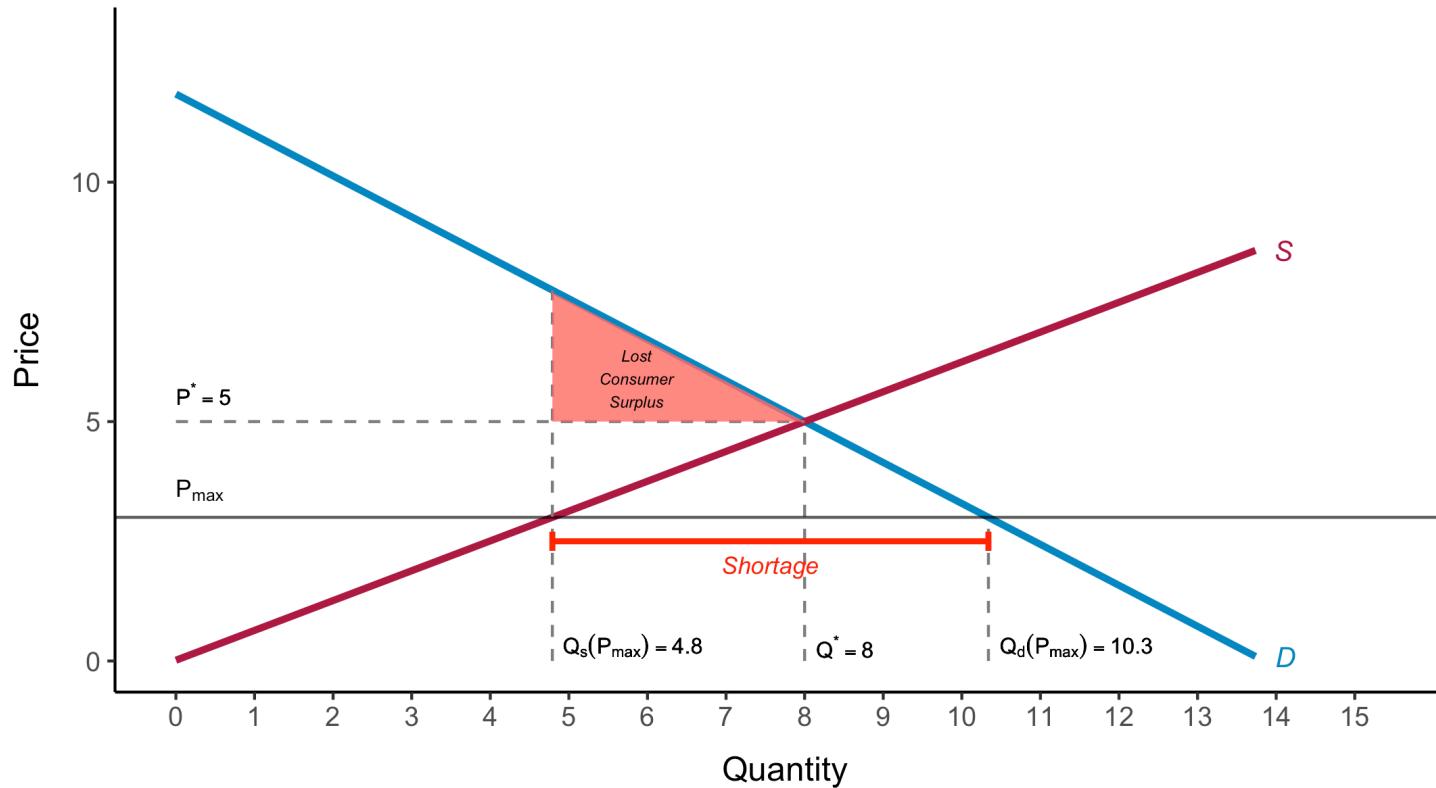
Change in Consumer Surplus



- Worse off: rationed out of the market since $Q_s(P_{max}) < Q^*$

Welfare: Example - Price controls

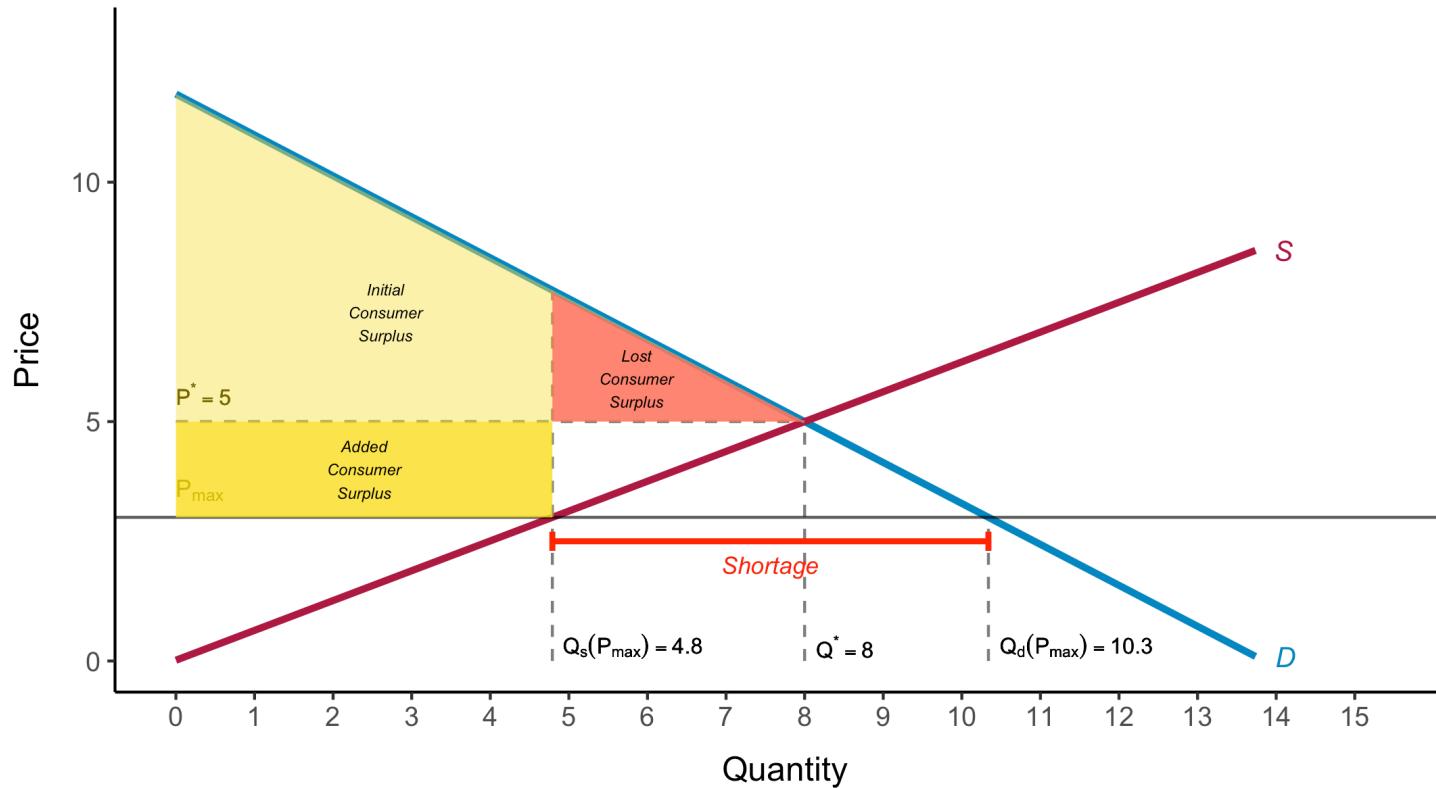
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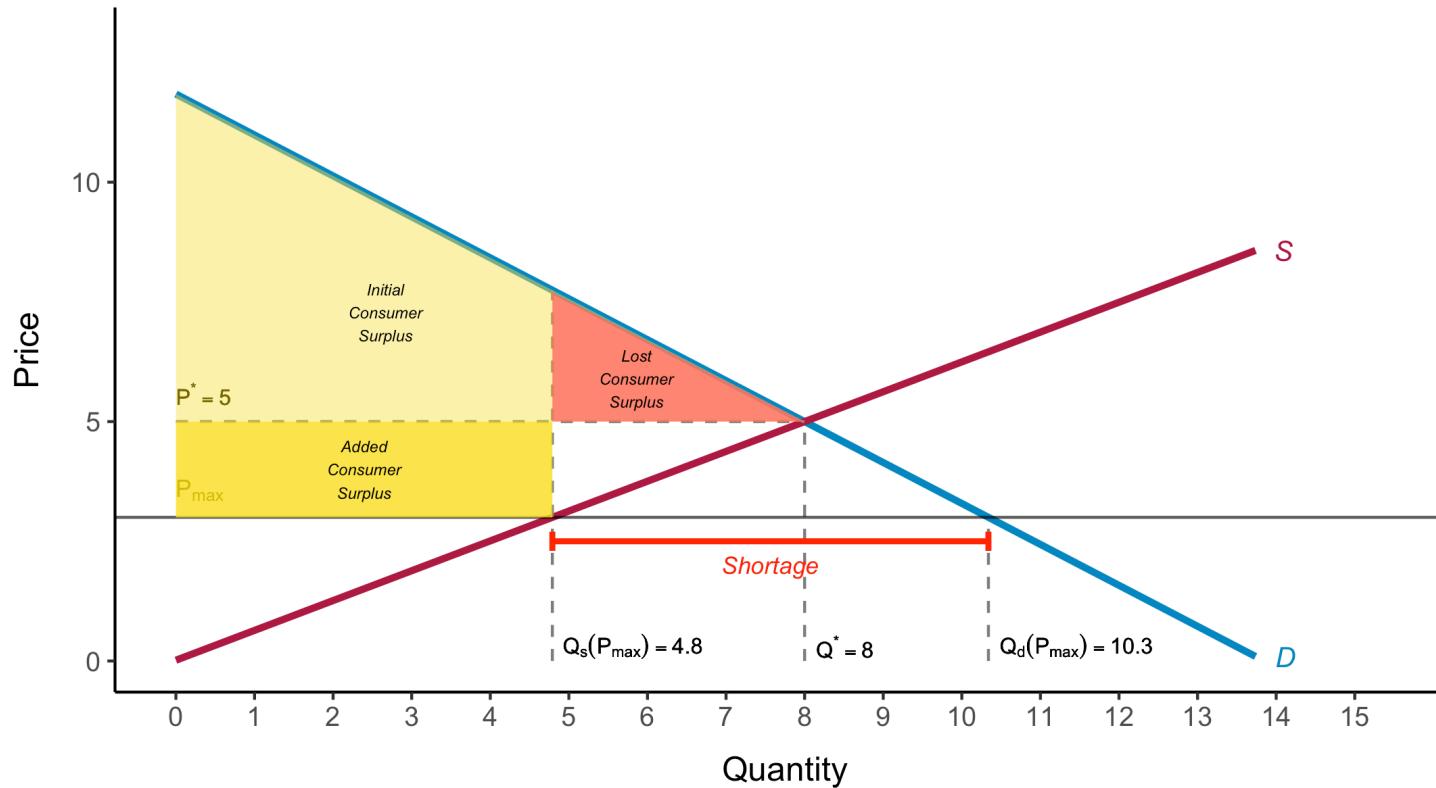
Change in Consumer Surplus: Added - Lost



$$\Delta CS \approx \text{Added } CS - \text{Lost } CS$$

Welfare: Example - Price controls

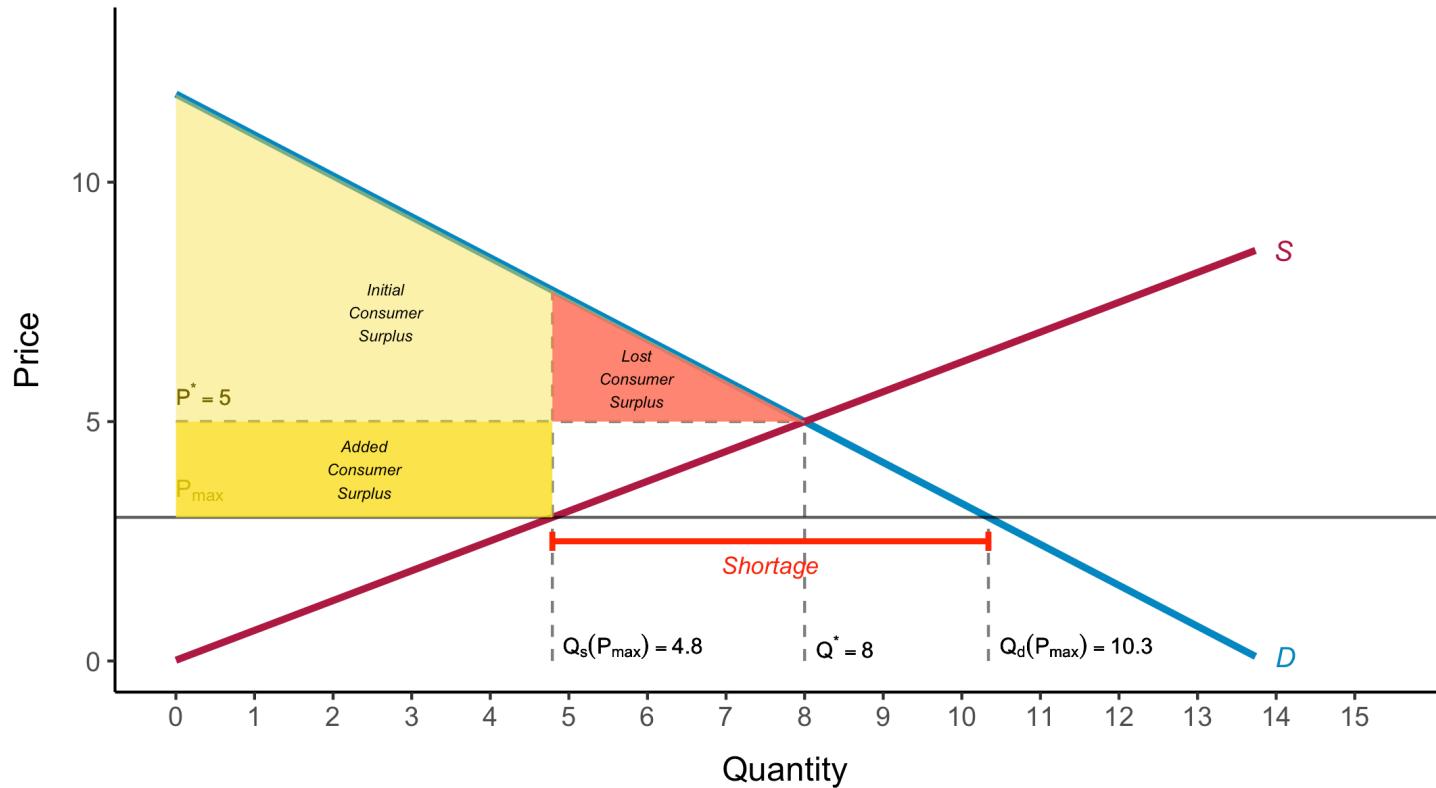
Change in Consumer Surplus: Added - Lost



$$\Delta CS \approx [(4.8) * (5 - 3)] - [(8 - 4.8) * (7.7 - 5)/2]$$

Welfare: Example - Price controls

Change in Consumer Surplus: Added - Lost



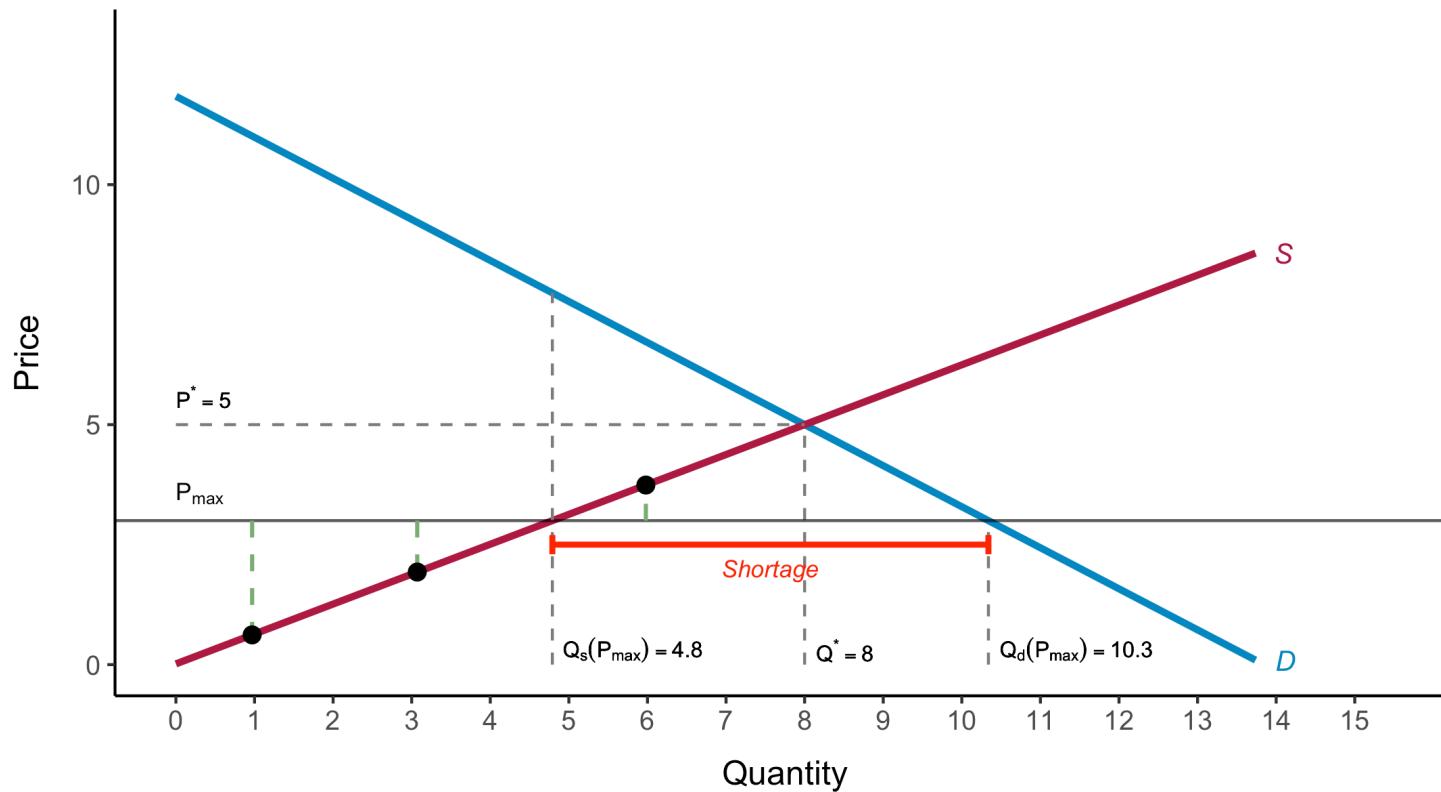
$$\Delta CS \approx (9.6) - (4.3) \approx 5.3 > 0$$

Welfare: Example - Price controls

Change in Producer Surplus: Producers with low production costs will stay in the market, but will receive a lower price for their output, while other producers will leave the market.

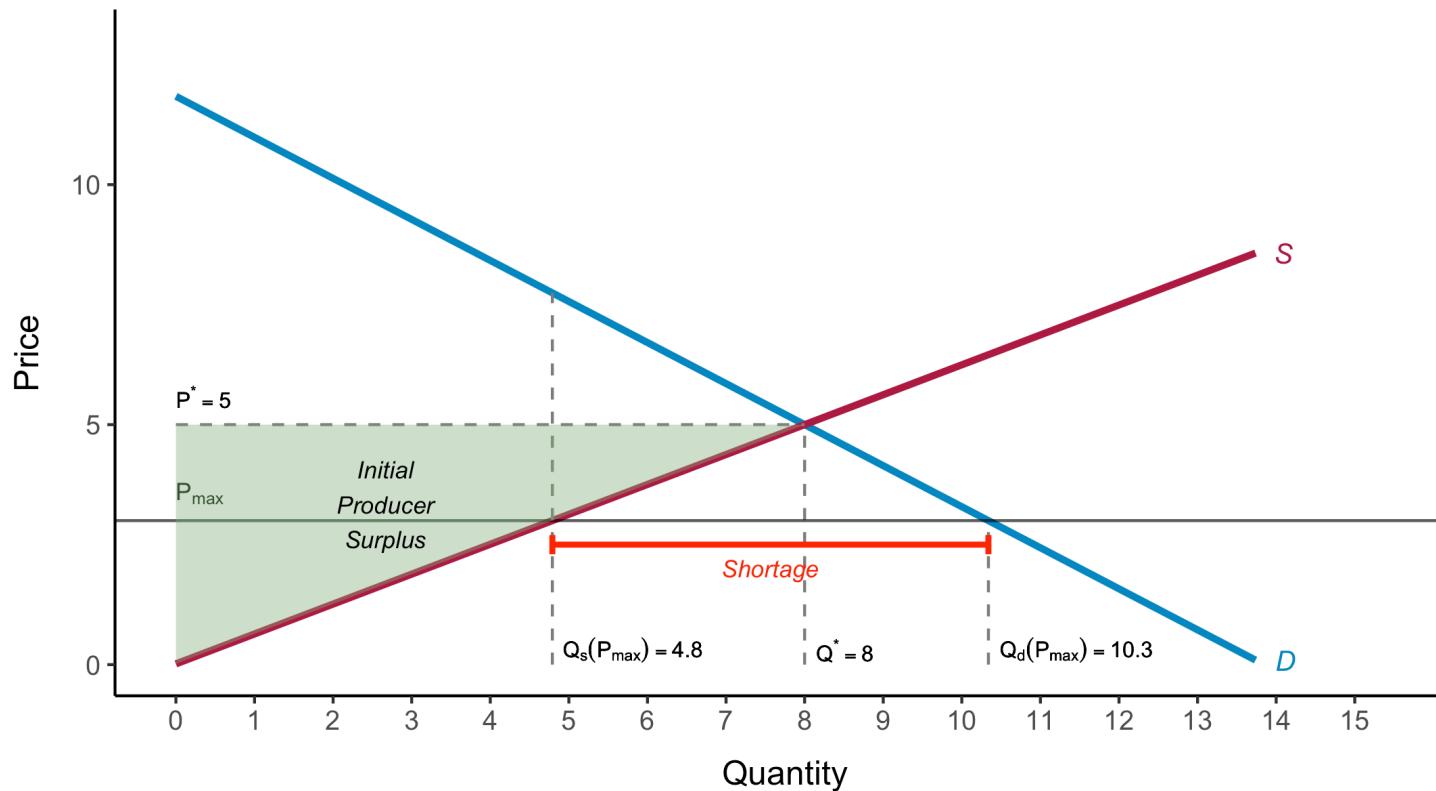
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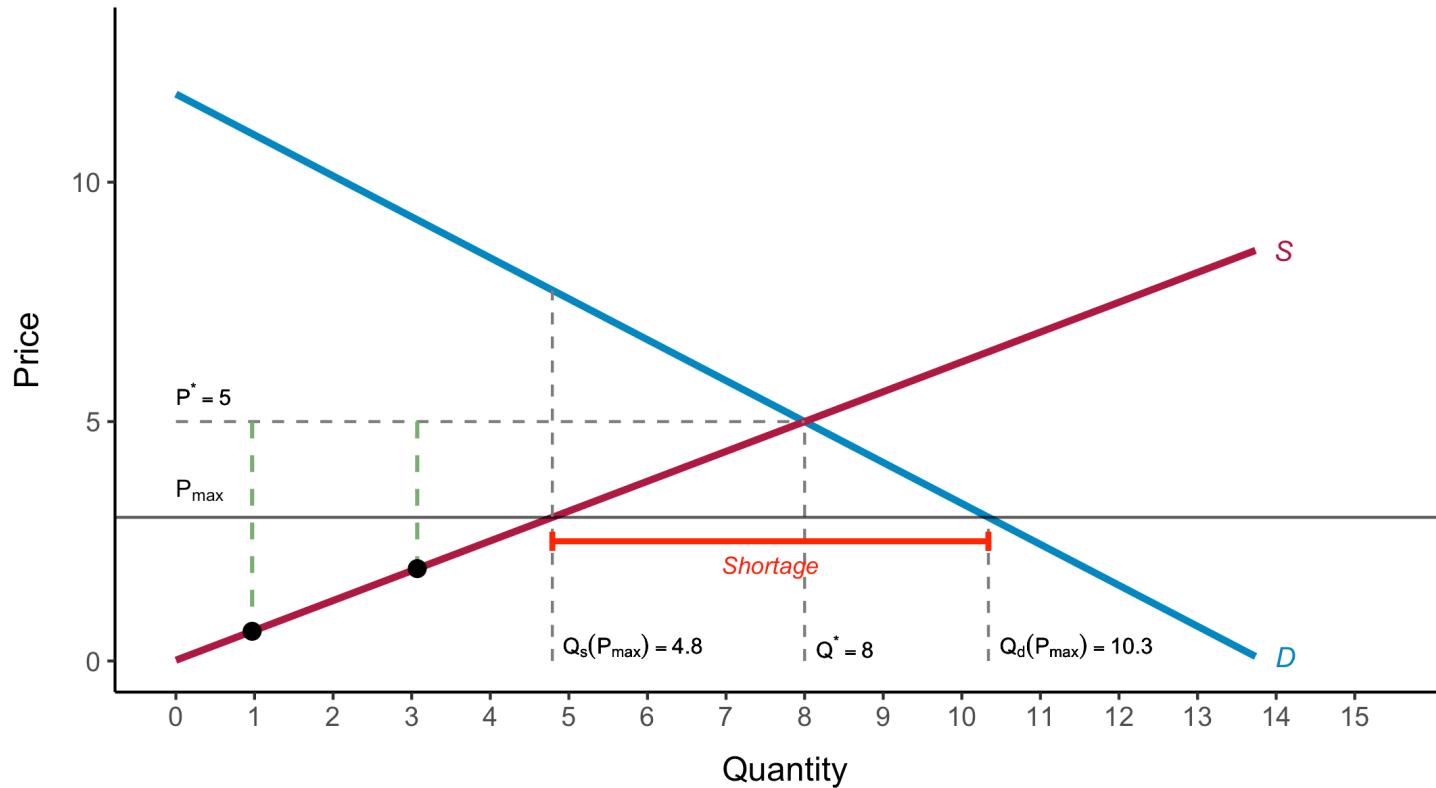
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Recall, net benefit to producer i : $P_{max} - WTS_i$ and initial Consumer Surplus



Welfare: Example - Price controls

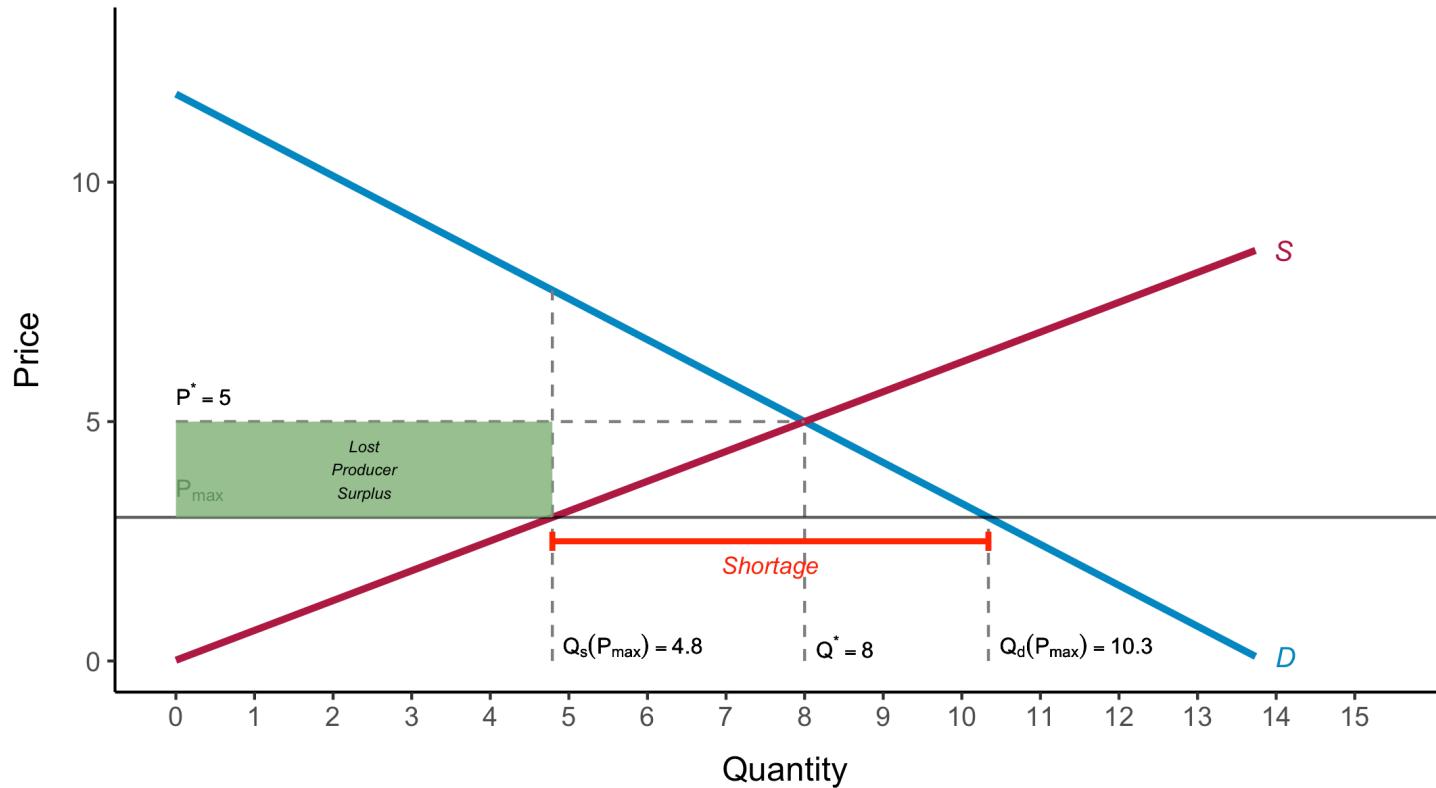
Change in Producer Surplus



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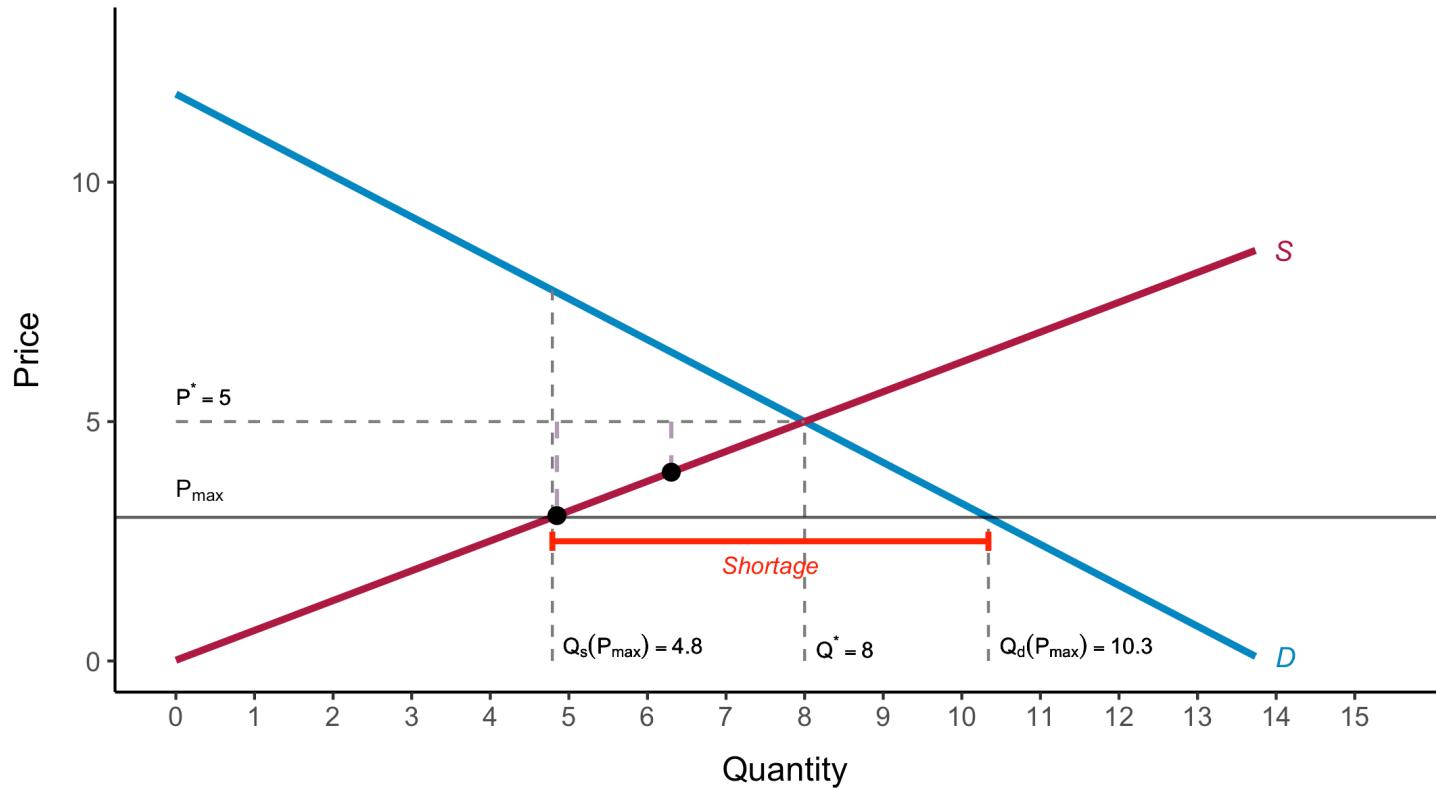
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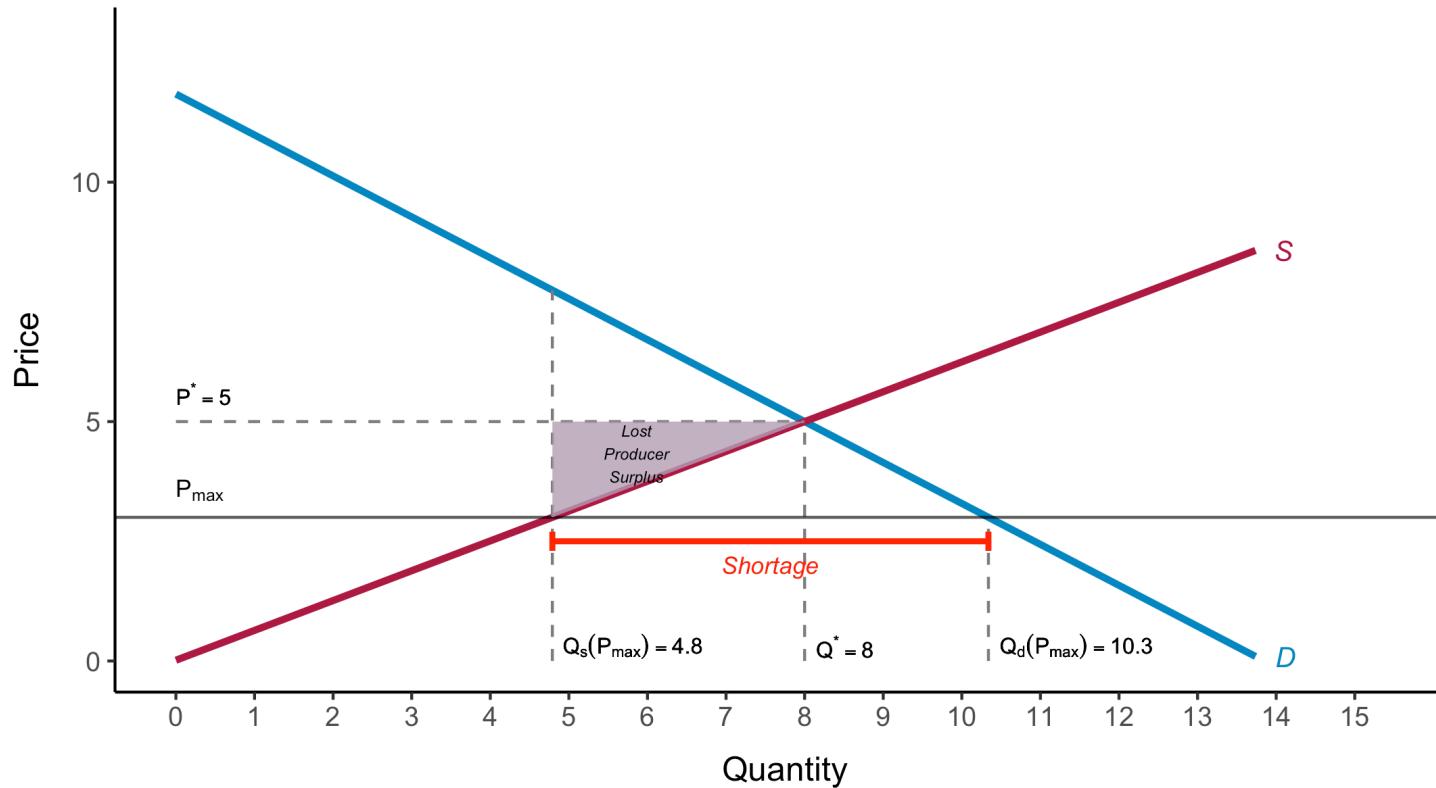
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- Worse off: Other producers will leave the market.

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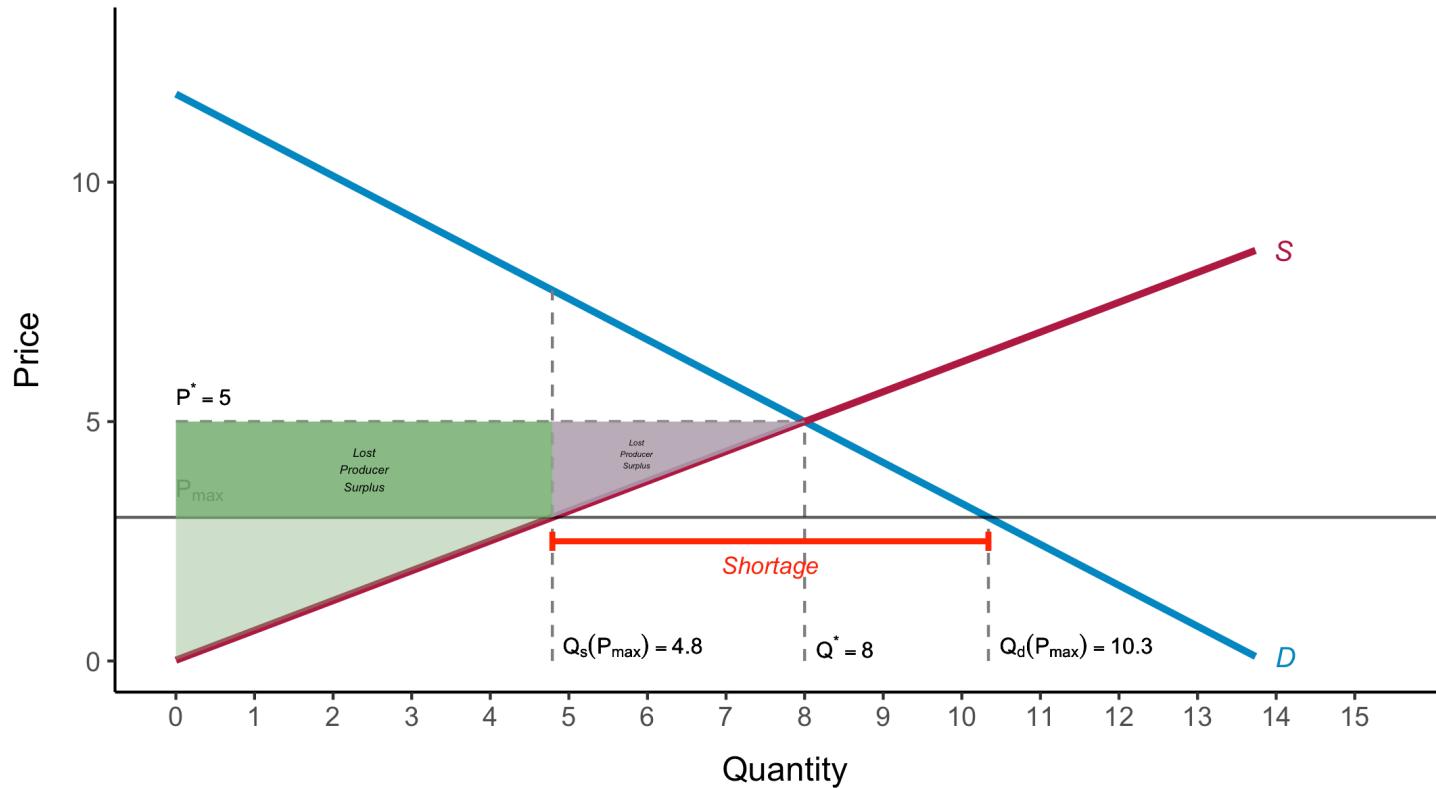
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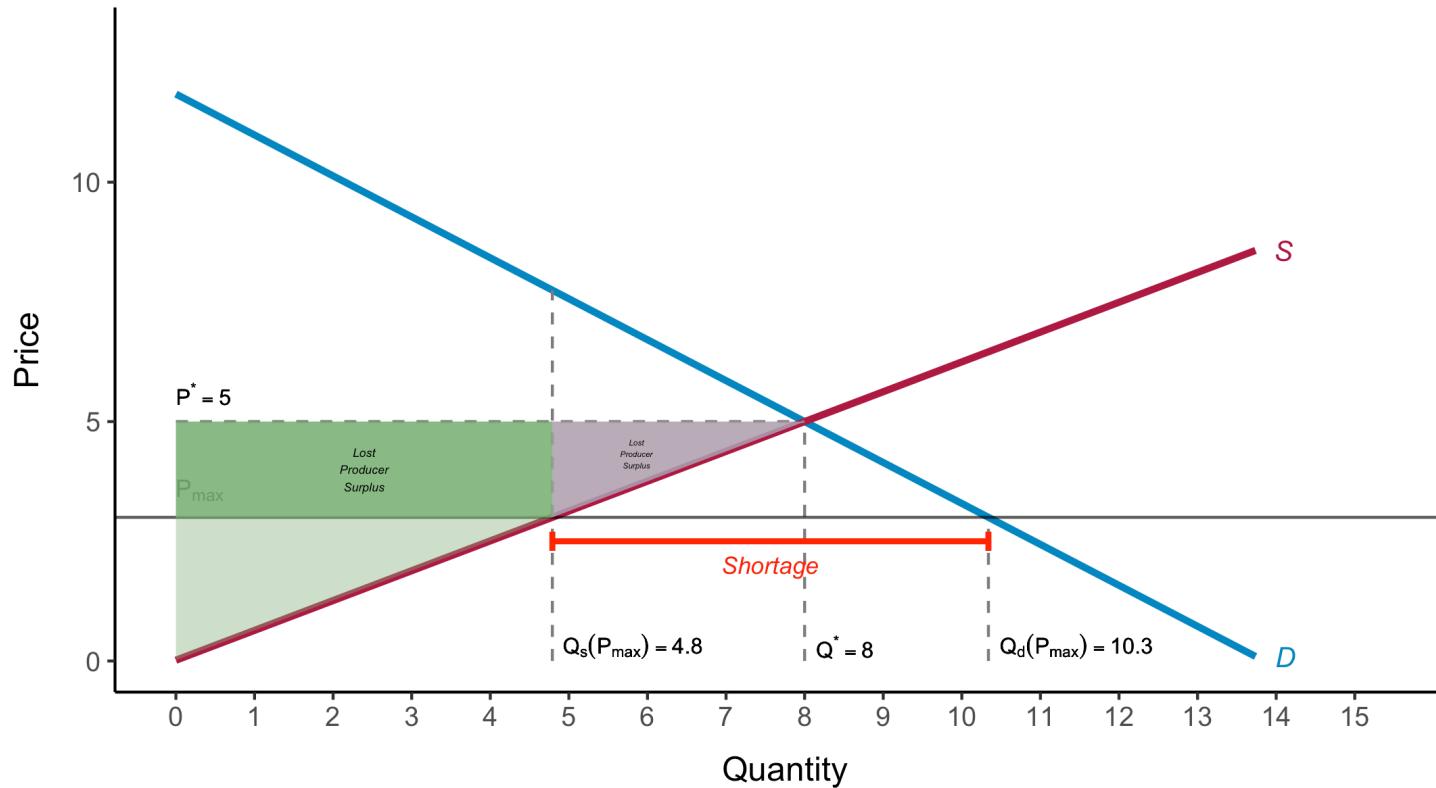
Change in Producer Surplus: - Lost #1 - Lost #2



$$\Delta PS = -\text{Lost } \#1 - \text{Lost } \#2$$

Welfare: Example - Price controls

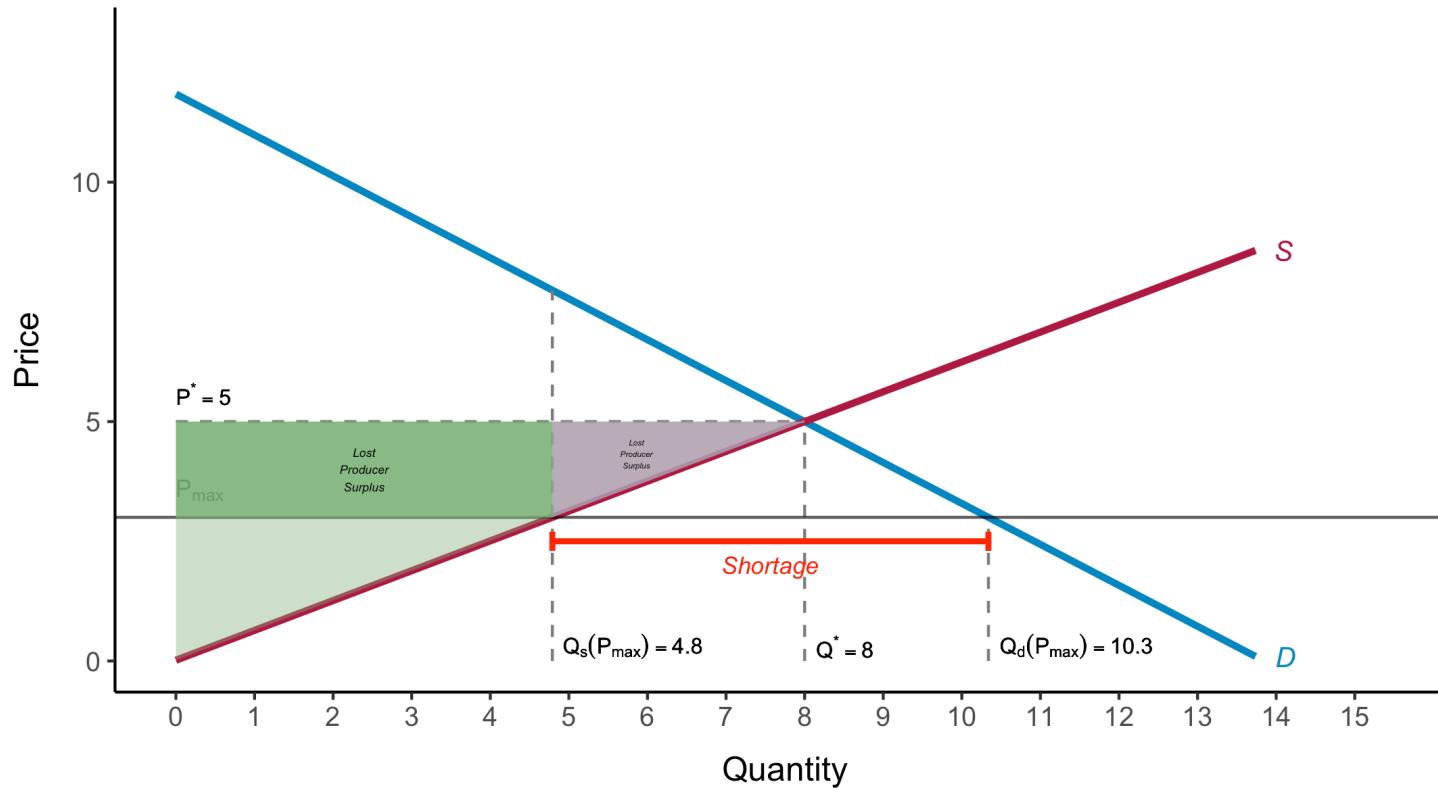
Change in Producer Surplus: - Lost #1 - Lost #2



$$\Delta PS \approx -[(4.8) * (5 - 3)] - [(8 - 4.8) * (5 - 3)/2]$$

Welfare: Example - Price controls

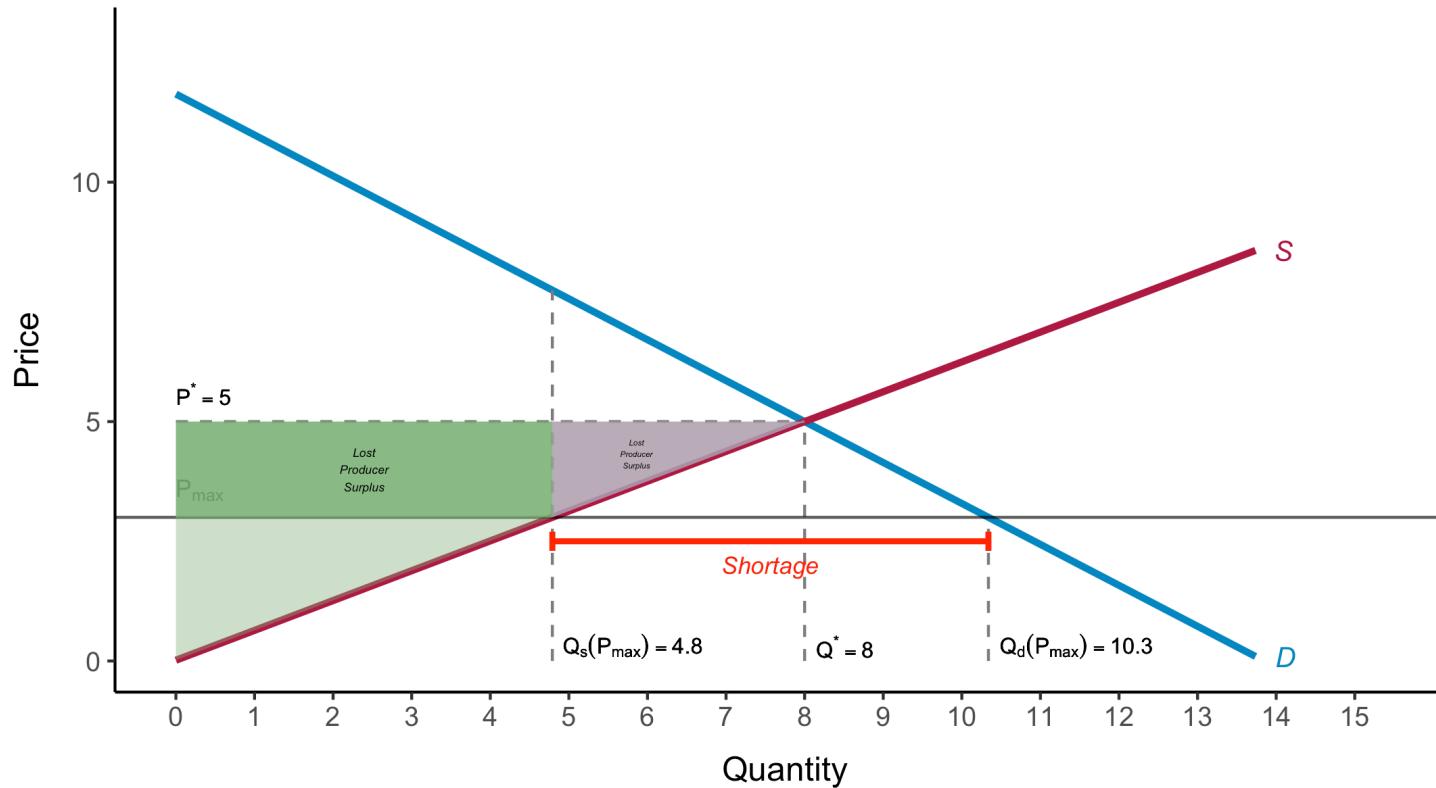
Change in Producer Surplus: - Lost #1 - Lost #2



$$\Delta PS \approx -(9.6) - (3.2) \approx -12.8$$

Welfare: Example - Price controls

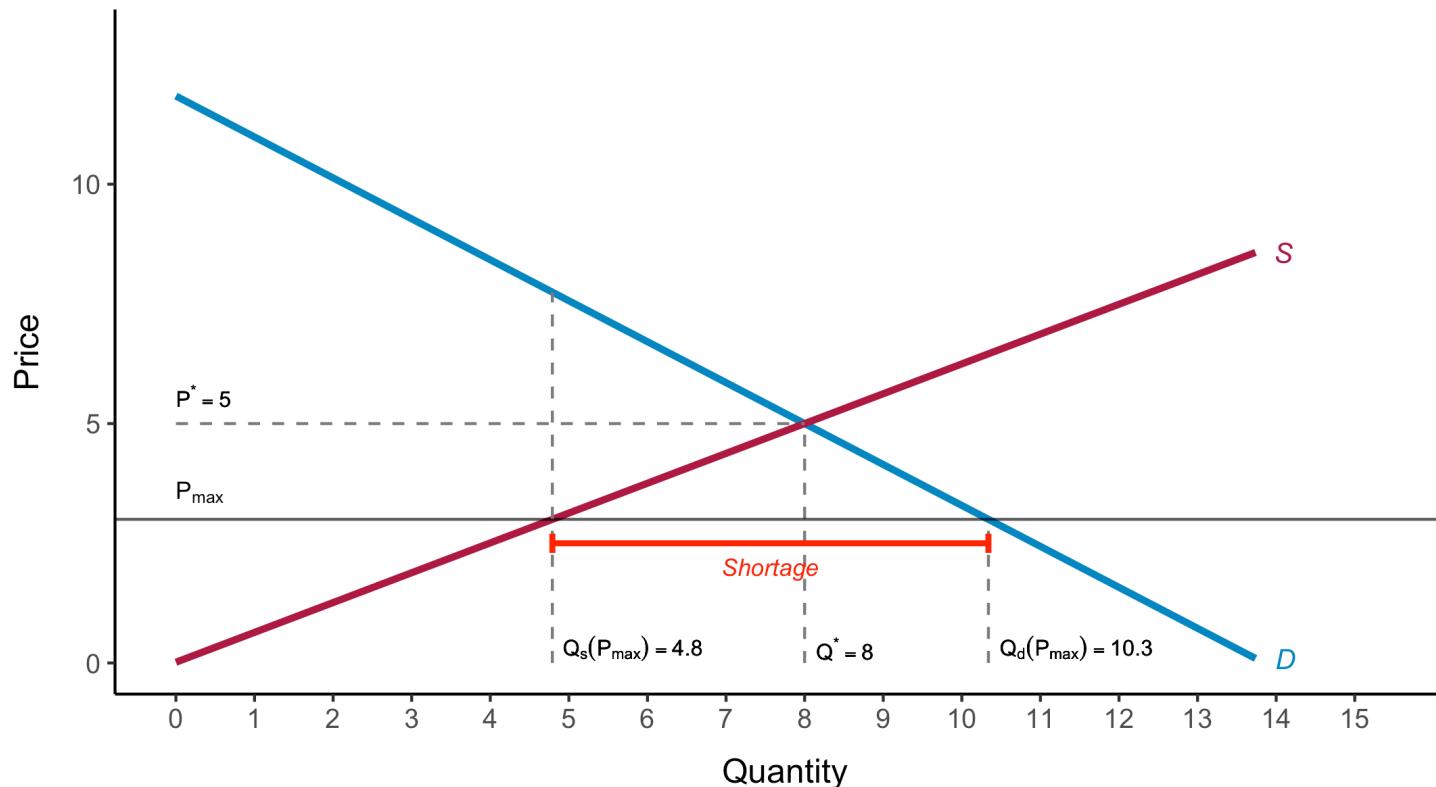
Change in Producer Surplus: Producers clearly lose as a result of price controls



Welfare: Example - Price controls

Is the loss to producers from price controls offset by the gain to consumers?

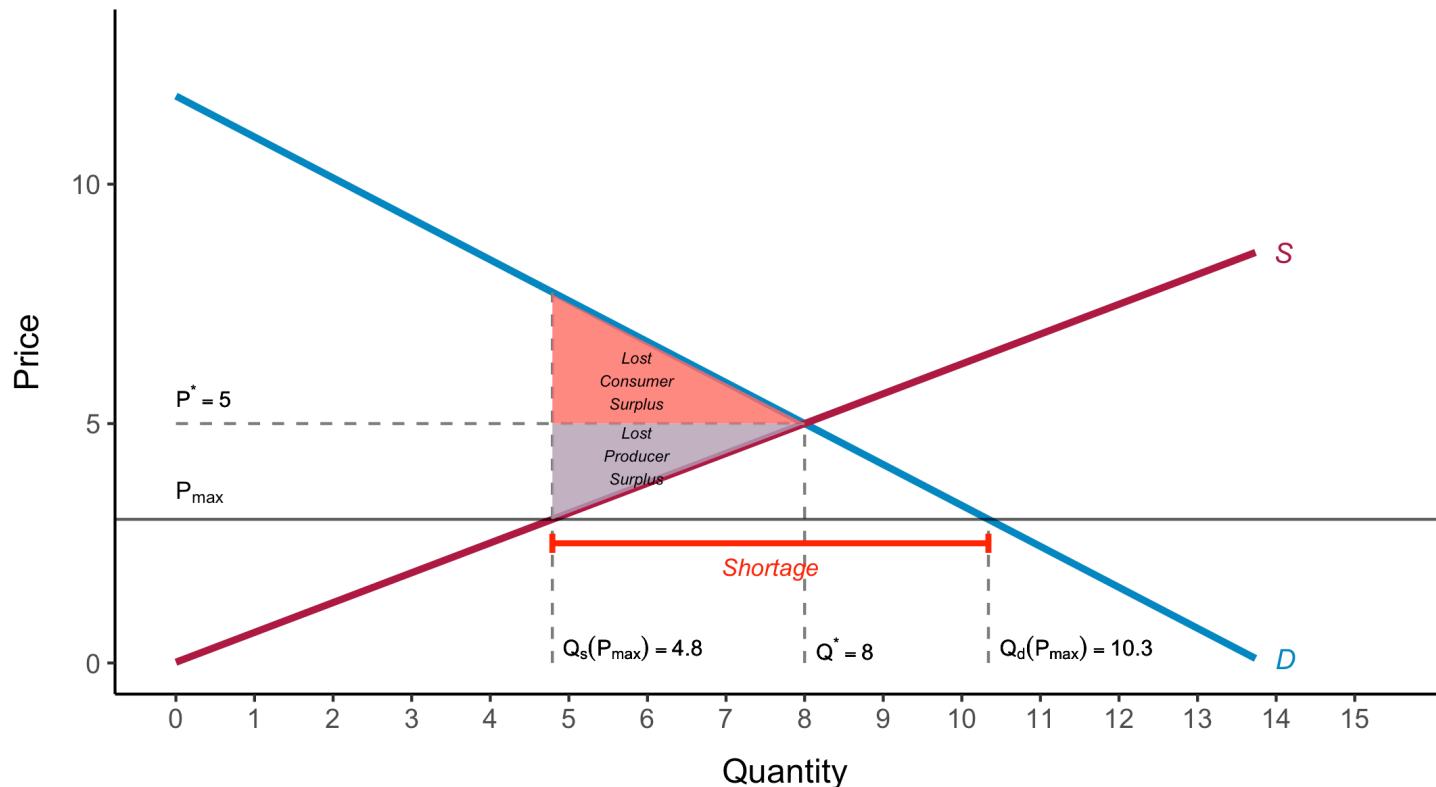
Deadweight loss: Net loss of total (consumer plus producer) surplus.



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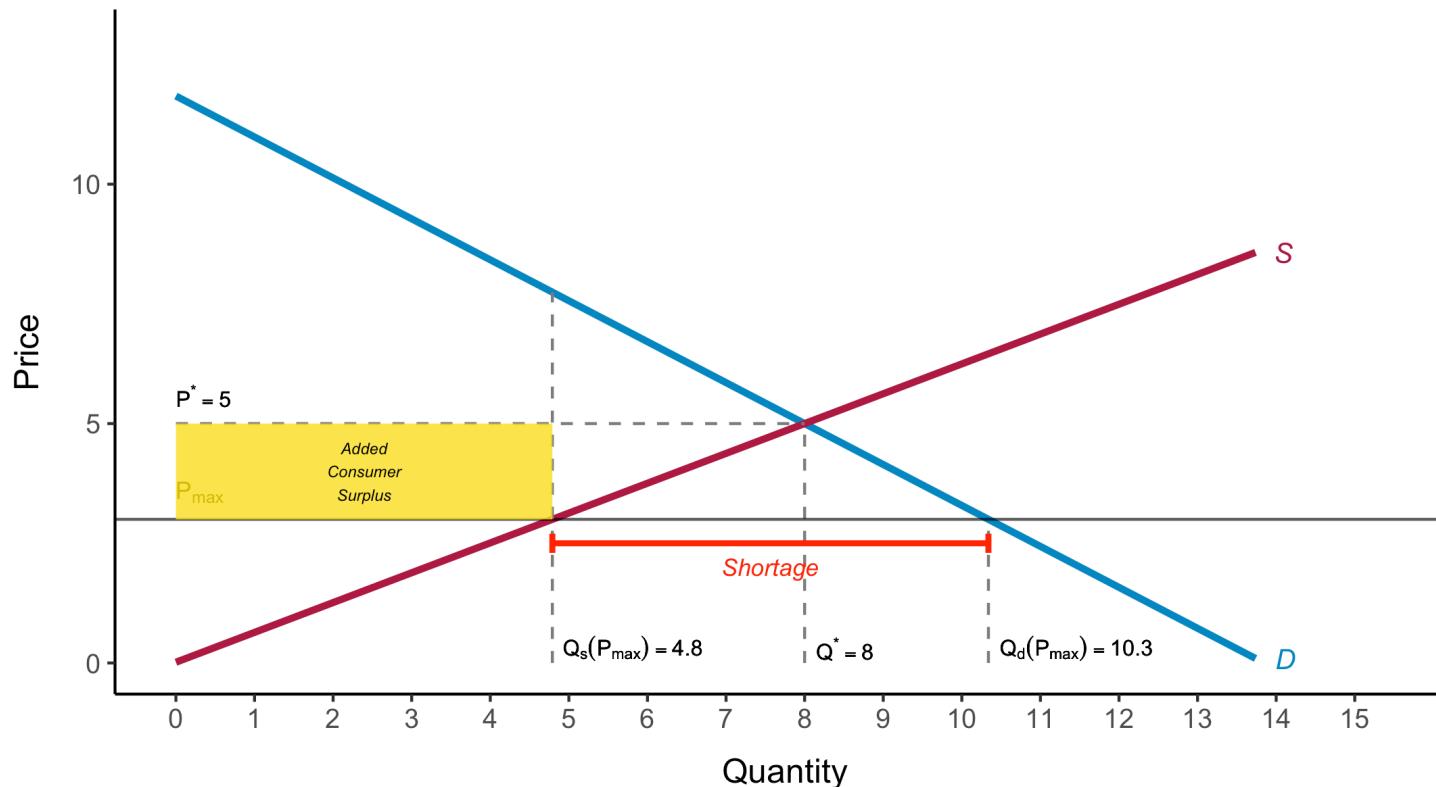
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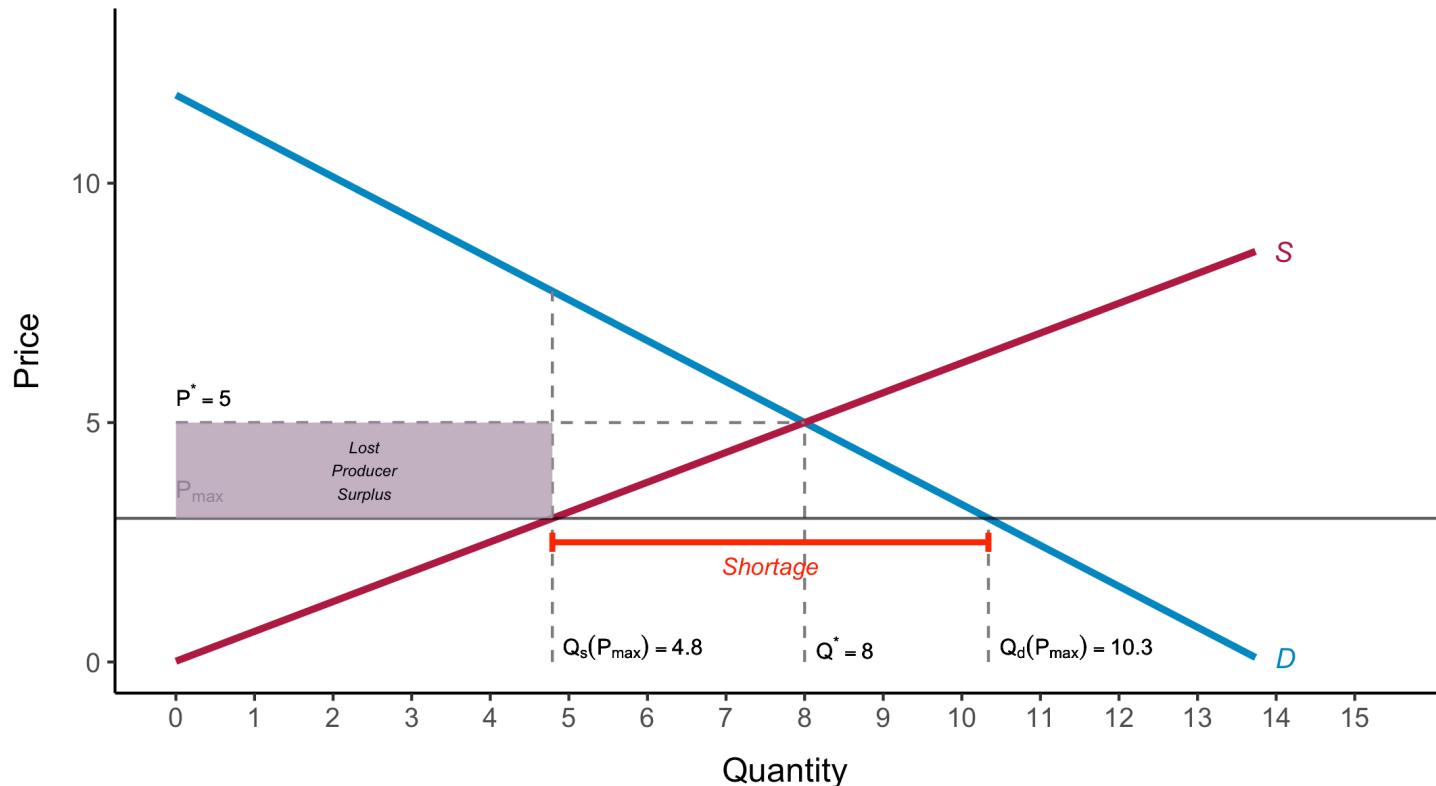
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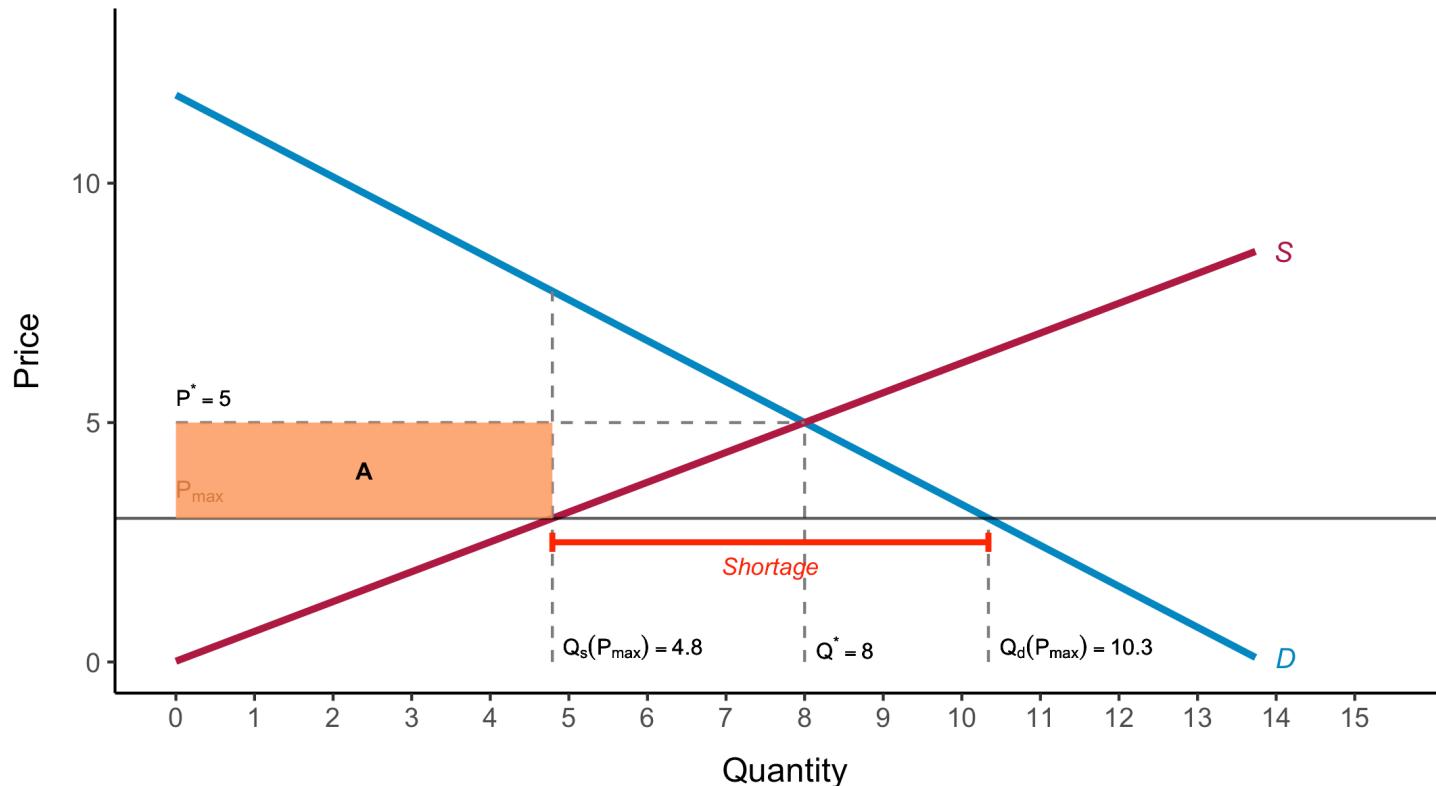
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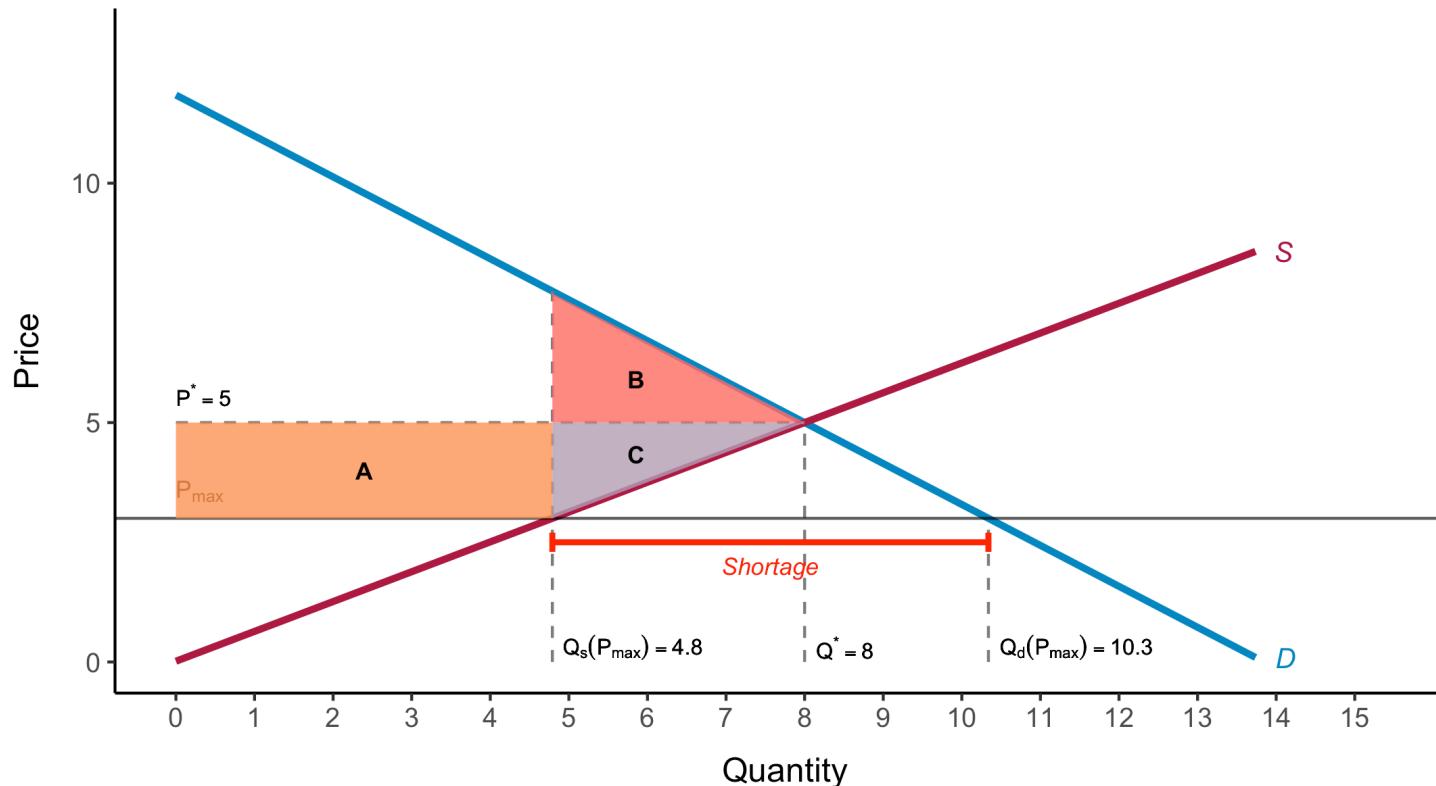
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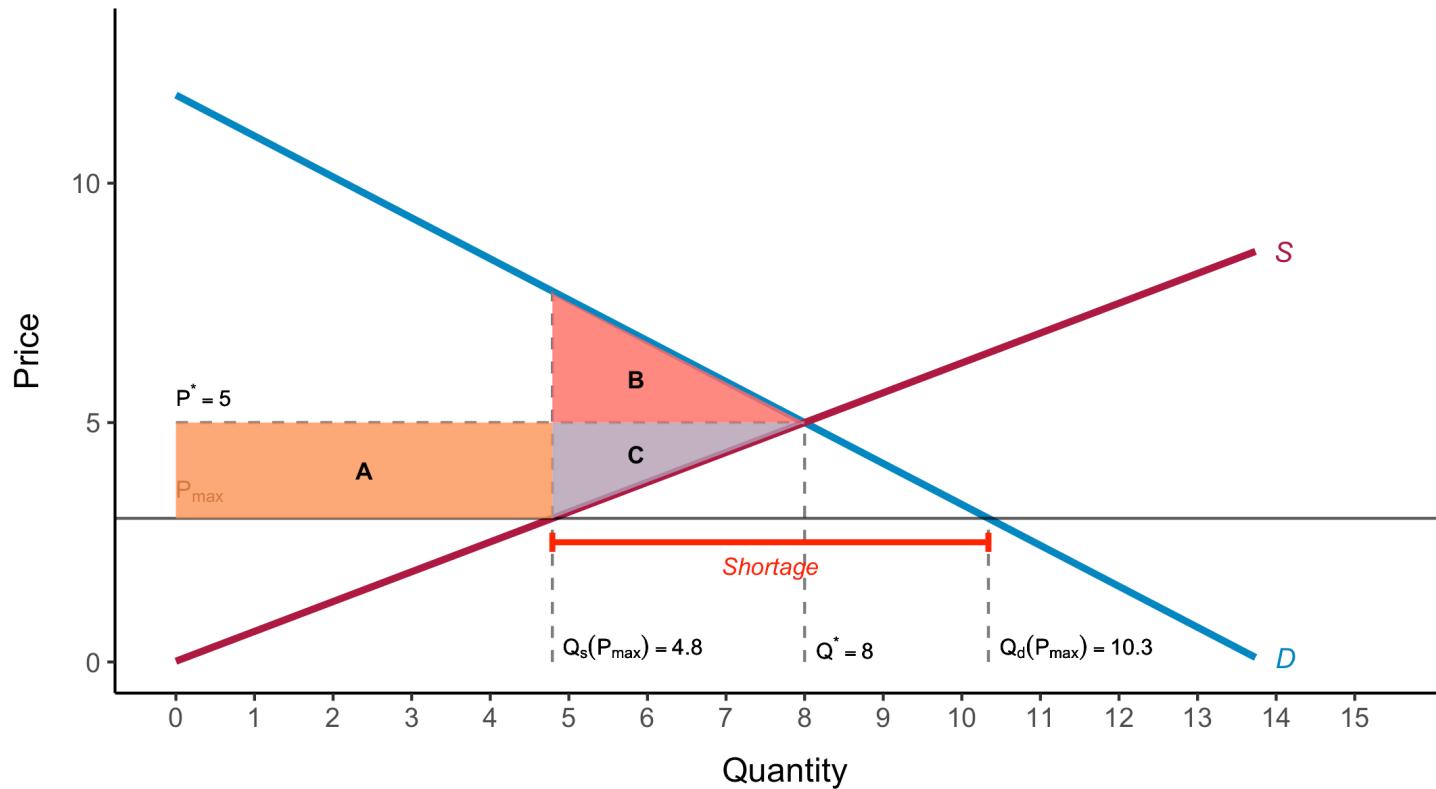
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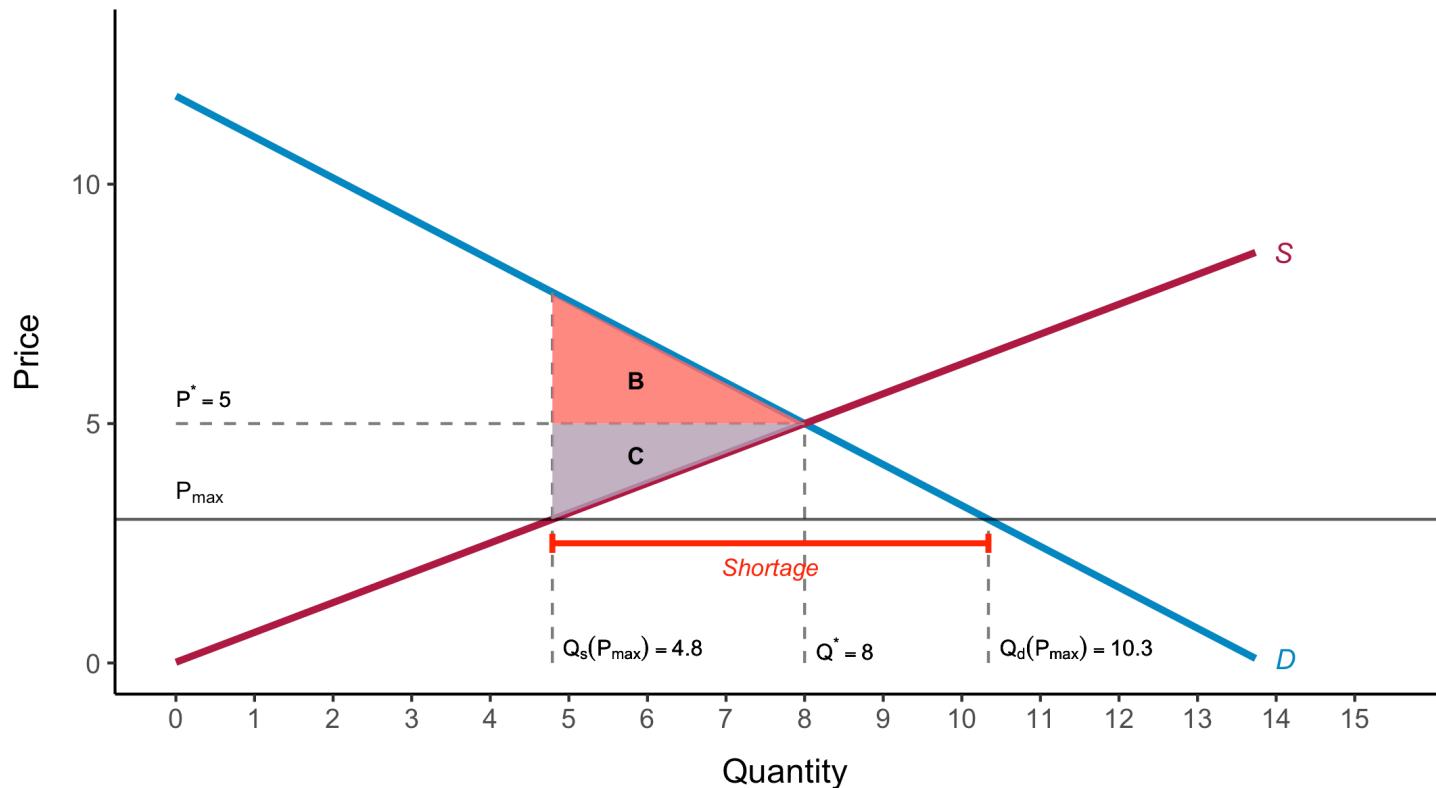
$$\text{Deadweight loss} = \Delta CS + \Delta PS$$



Welfare: Example - Price controls

Is the loss to producers from price controls offset by the gain to consumers? **No.**

$$\text{Deadweight loss} = (A - B) + (-A - C) = -B - C$$



Recall: Which type of market are we studying?

Welfare: Is the producer always the one losing?

No. Consumers can also be worse off. It will depend on the **Demand (price) elasticity**: how much consumers' demand for a good will change if the price changes.

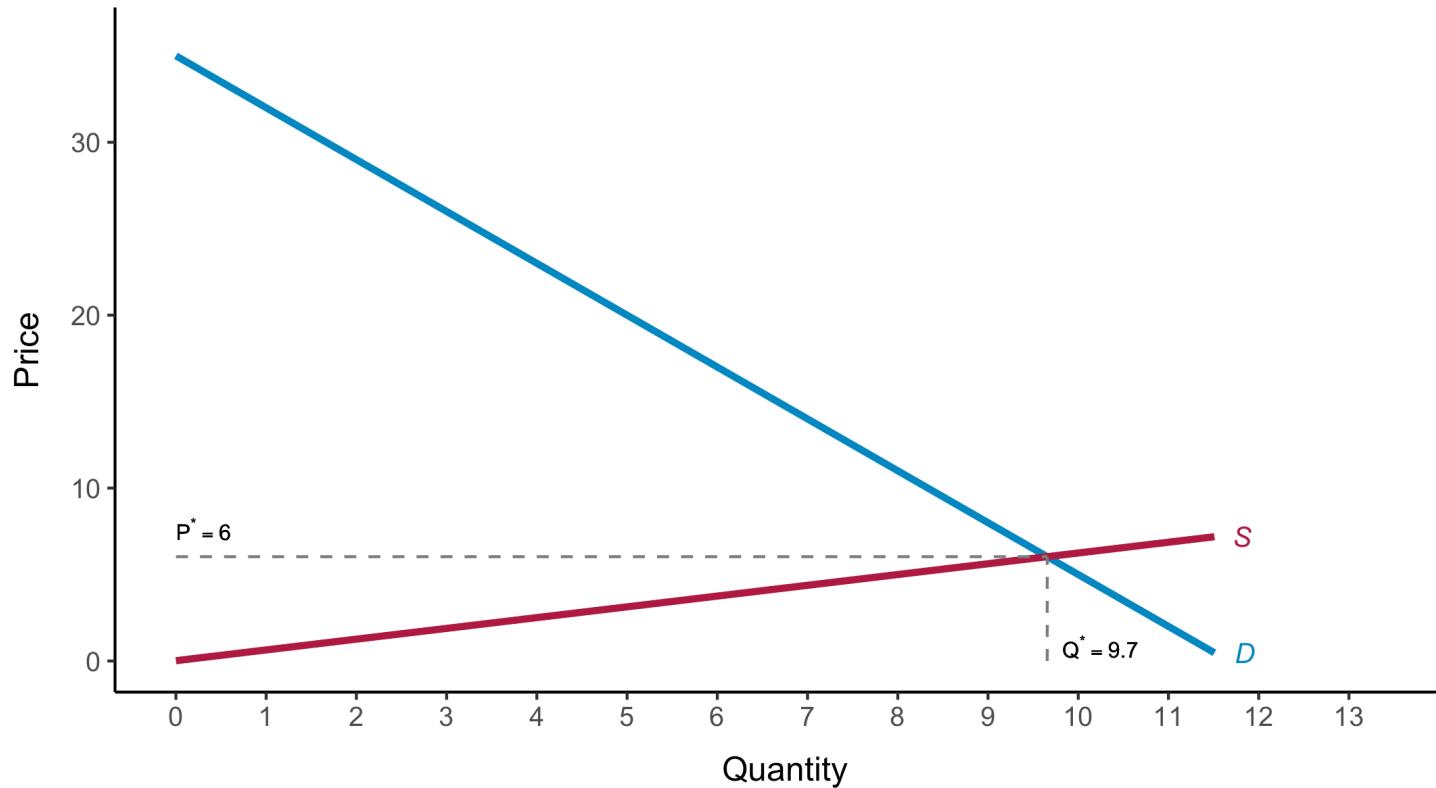
$$\varepsilon = -\frac{\% \text{change in demand}}{\% \text{change in price}} = -\frac{100(\frac{\Delta Q}{Q})}{100(\frac{\Delta P}{P})}$$

Which functional form for the demand function allow us to estimate price elasticity? Logarithmic function.

$$\ln(Q) = \ln(P) \Rightarrow \frac{d\ln(Q)}{dQ} = \frac{d\ln(P)}{dP} \iff \frac{\frac{1}{Q}}{dQ} = \frac{\frac{1}{P}}{dP} \iff \frac{dQ}{Q} = \frac{dP}{P}$$

Welfare: Is the producer always the one losing?

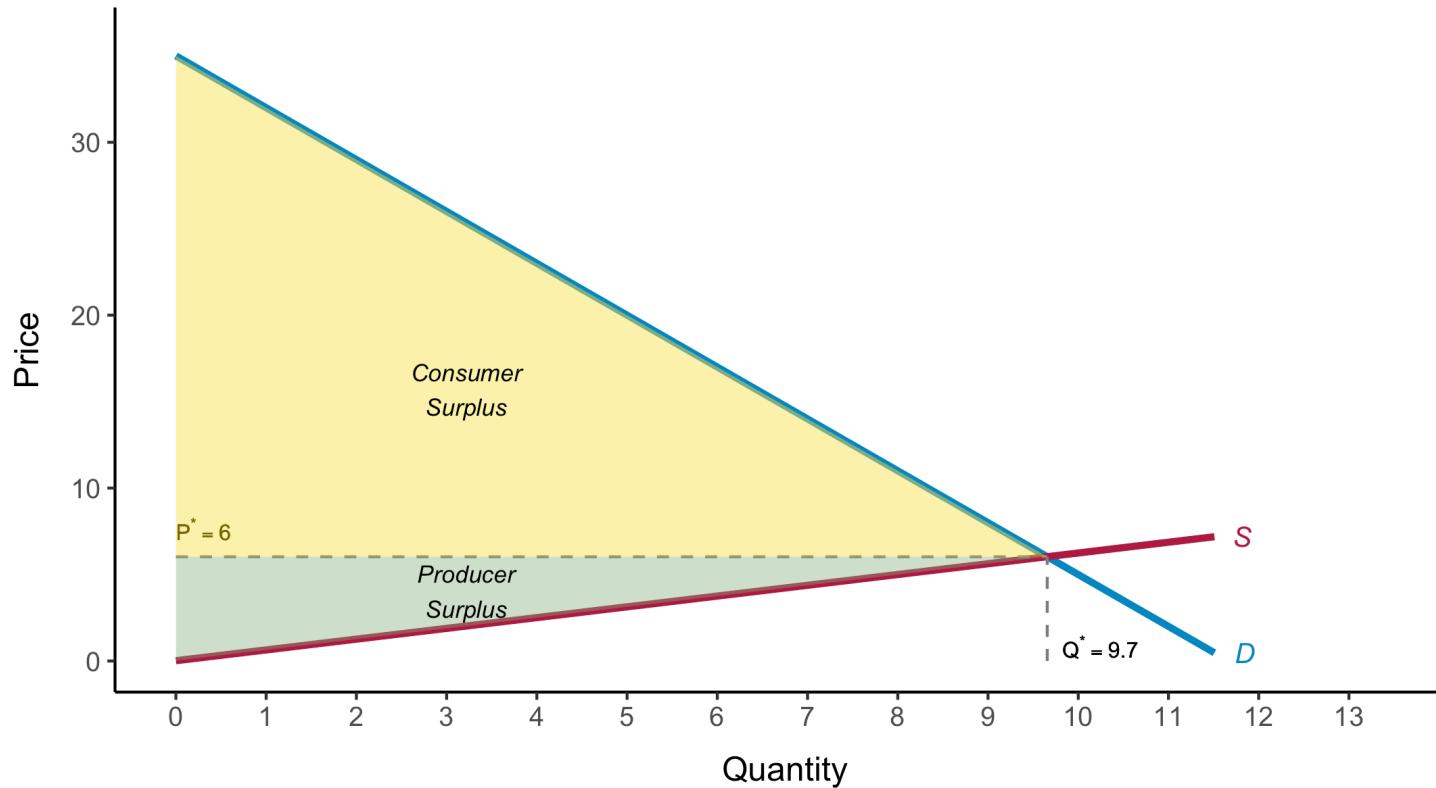
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$$Q_d = 35 - 3 \cdot P, \quad Q_s = 0.0155 + 0.623 \cdot P$$

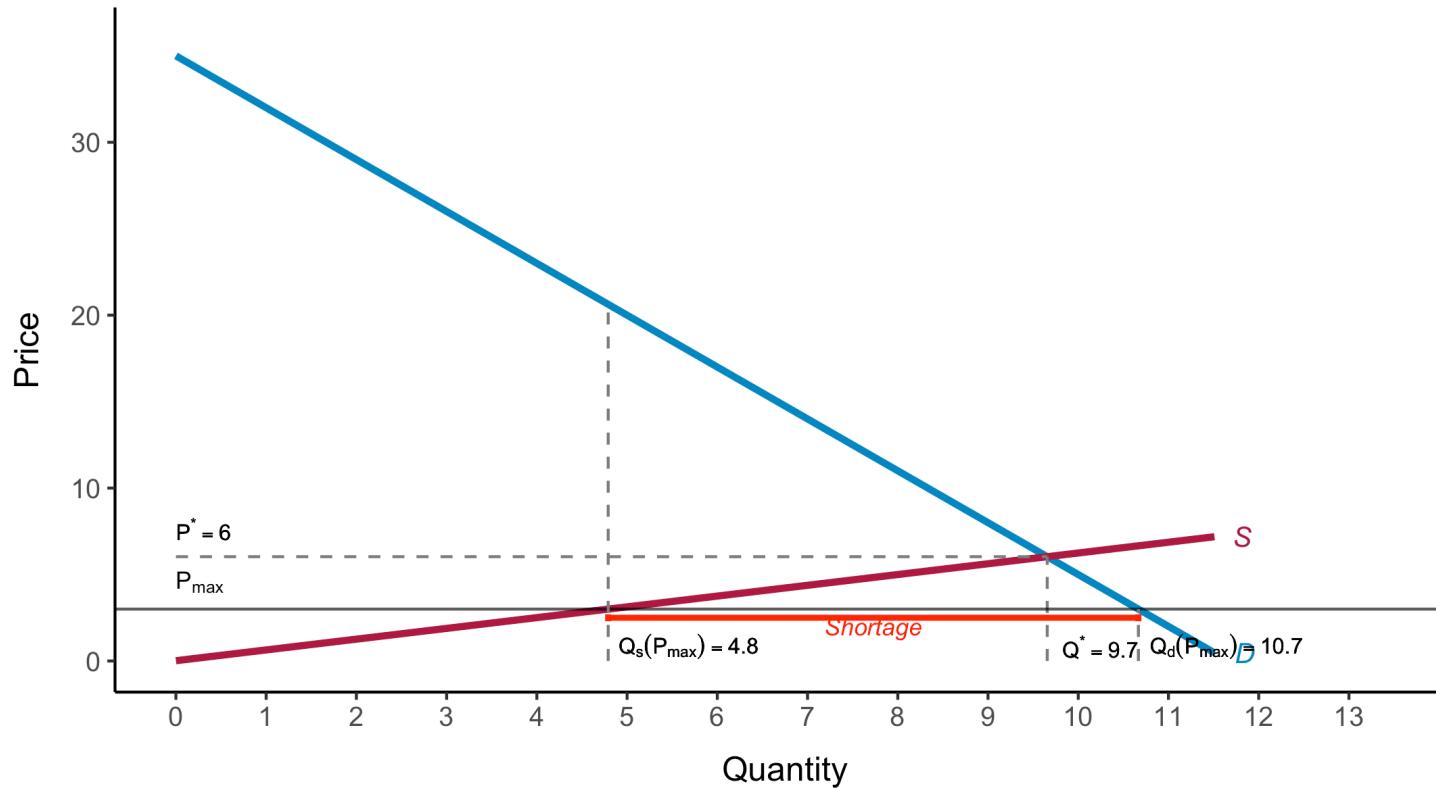
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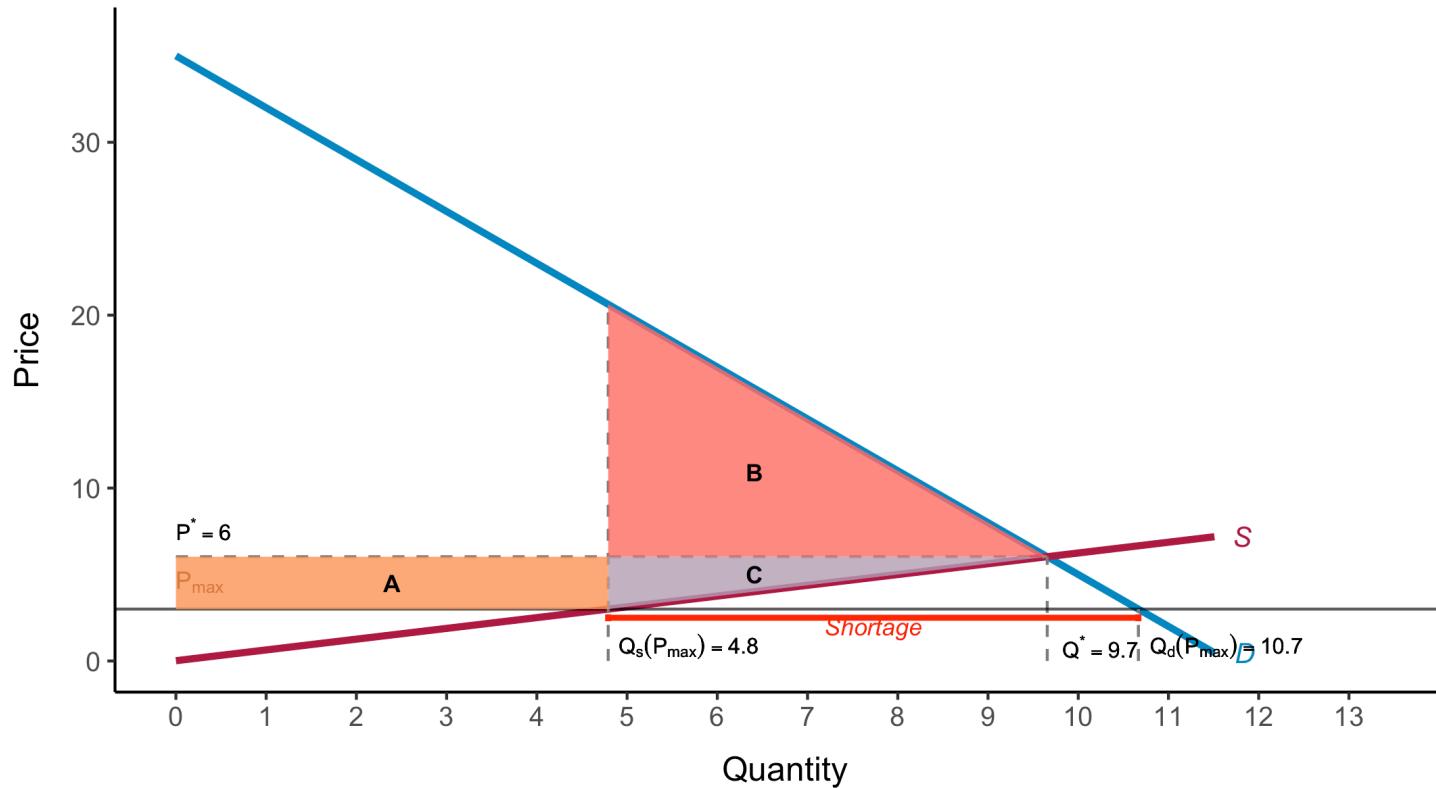
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The Efficiency of a Competitive Market

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To evaluate a market outcome, we often ask whether it achieves **economic efficiency**: maximization of aggregate consumer and producer surplus.

- Price controls create a **deadweight loss** ⇒ **efficiency cost**
- A market is efficient if it maximises the total surplus of the economy



Even competitive markets are not always efficient

Market Failures

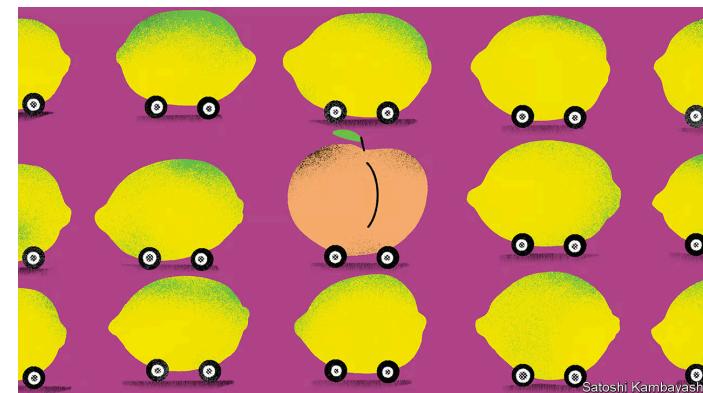
Market failures: Situation where prices fail to provide proper signals to consumers and producers.

⇒ unregulated competitive market is inefficient

1. Externalities: Action taken by either a producer or a consumer which affects other producers or consumers but is not accounted for by the market price.

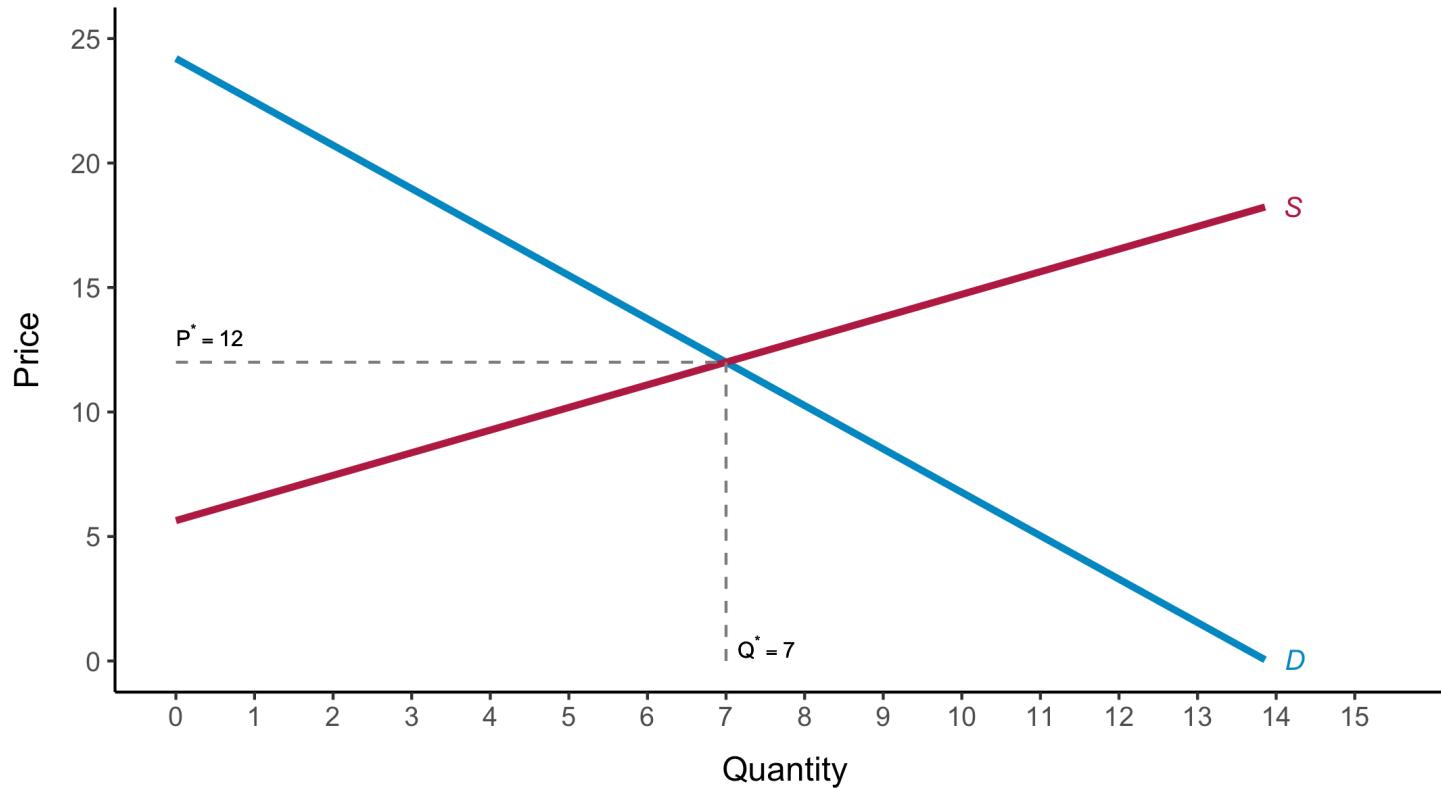


1. Imperfect information: Consumers lack information on the nature or quality of a product and cannot make decisions maximizing their utility.



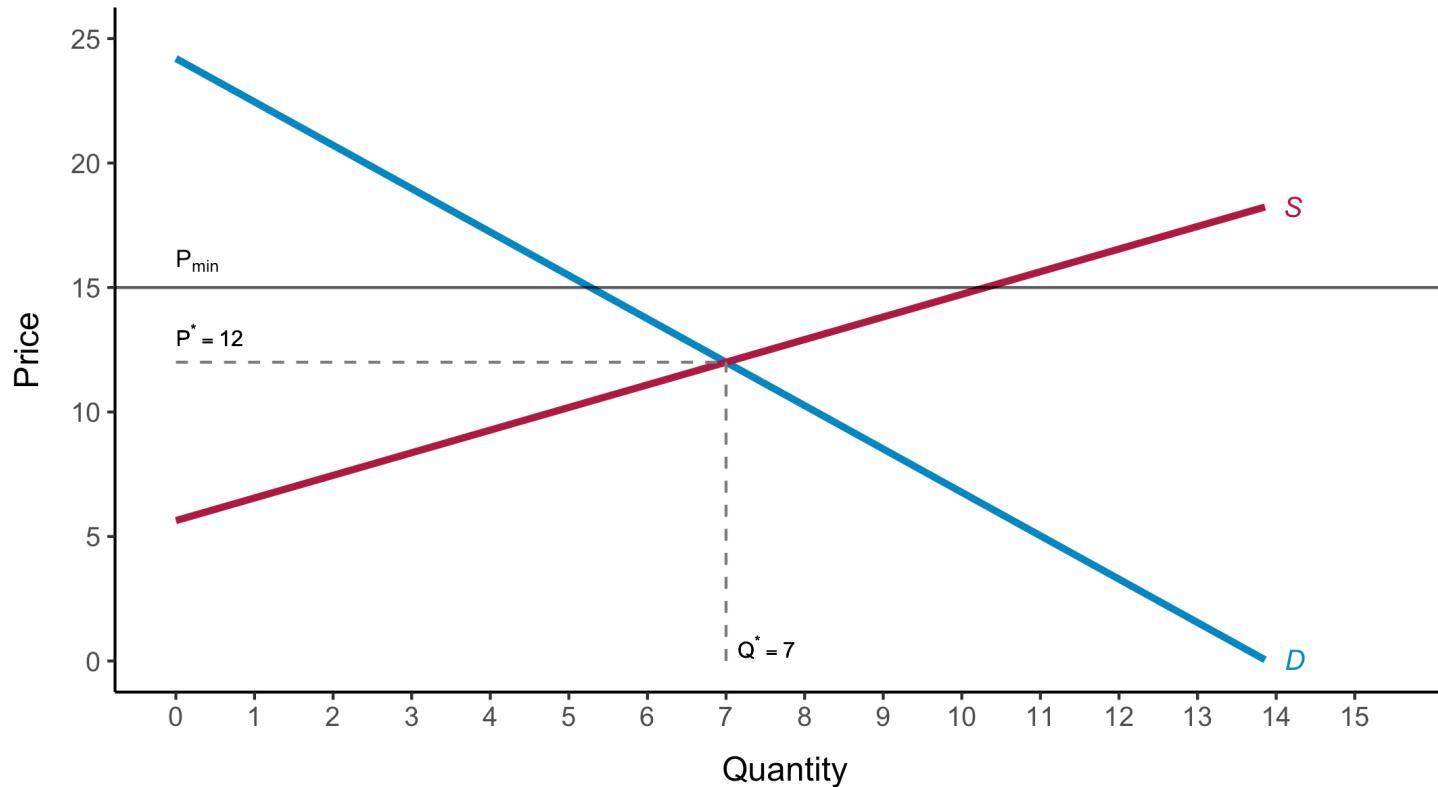
Minimum Prices

Minimum Prices



$$Q_d = 24.2 - 1.74 \cdot P, \quad Q_s = 5.64 + 0.909 \cdot P$$

Minimum Prices

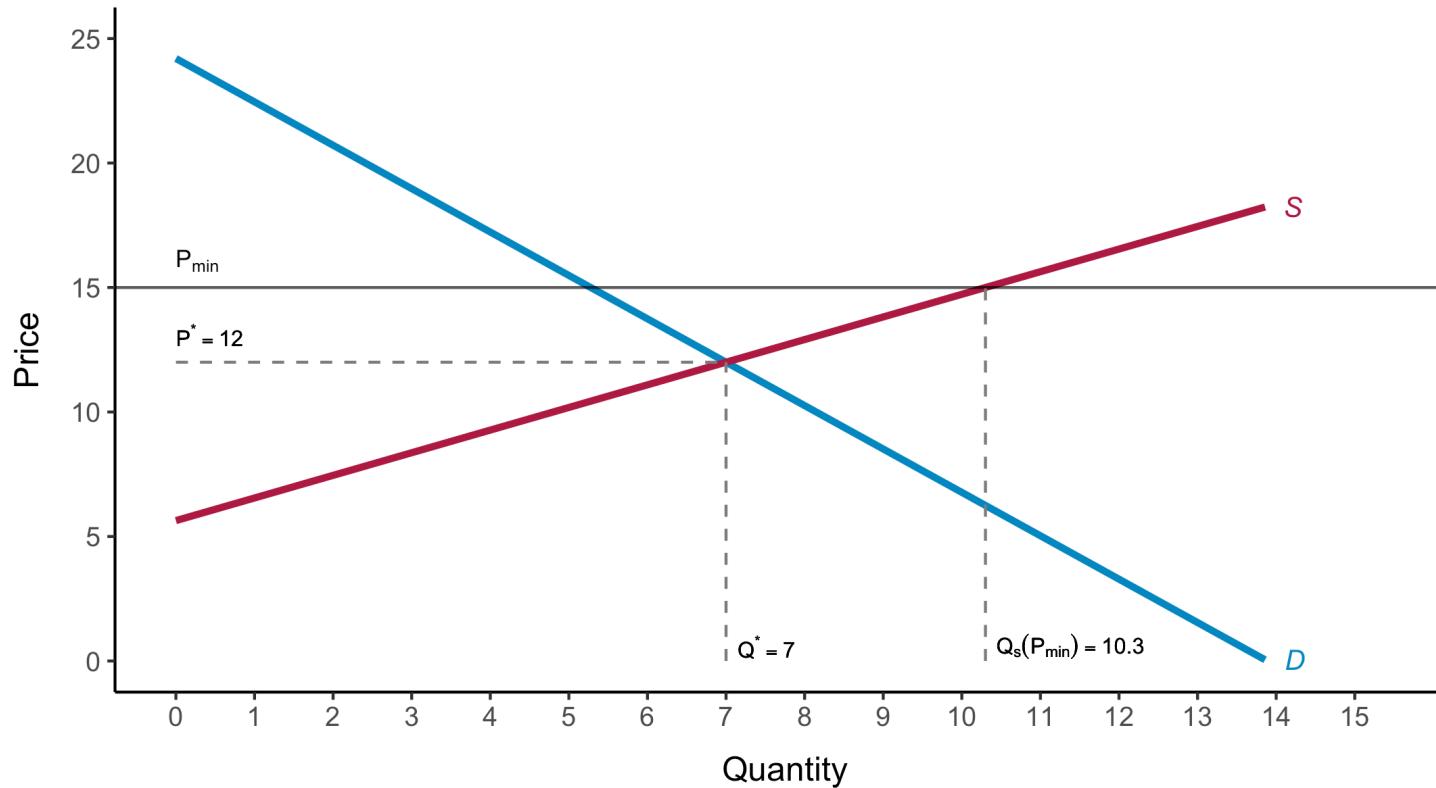


Price of a good/service has been regulated to be above the market-clearing price, $P_{min} = 15$

Minimum Prices

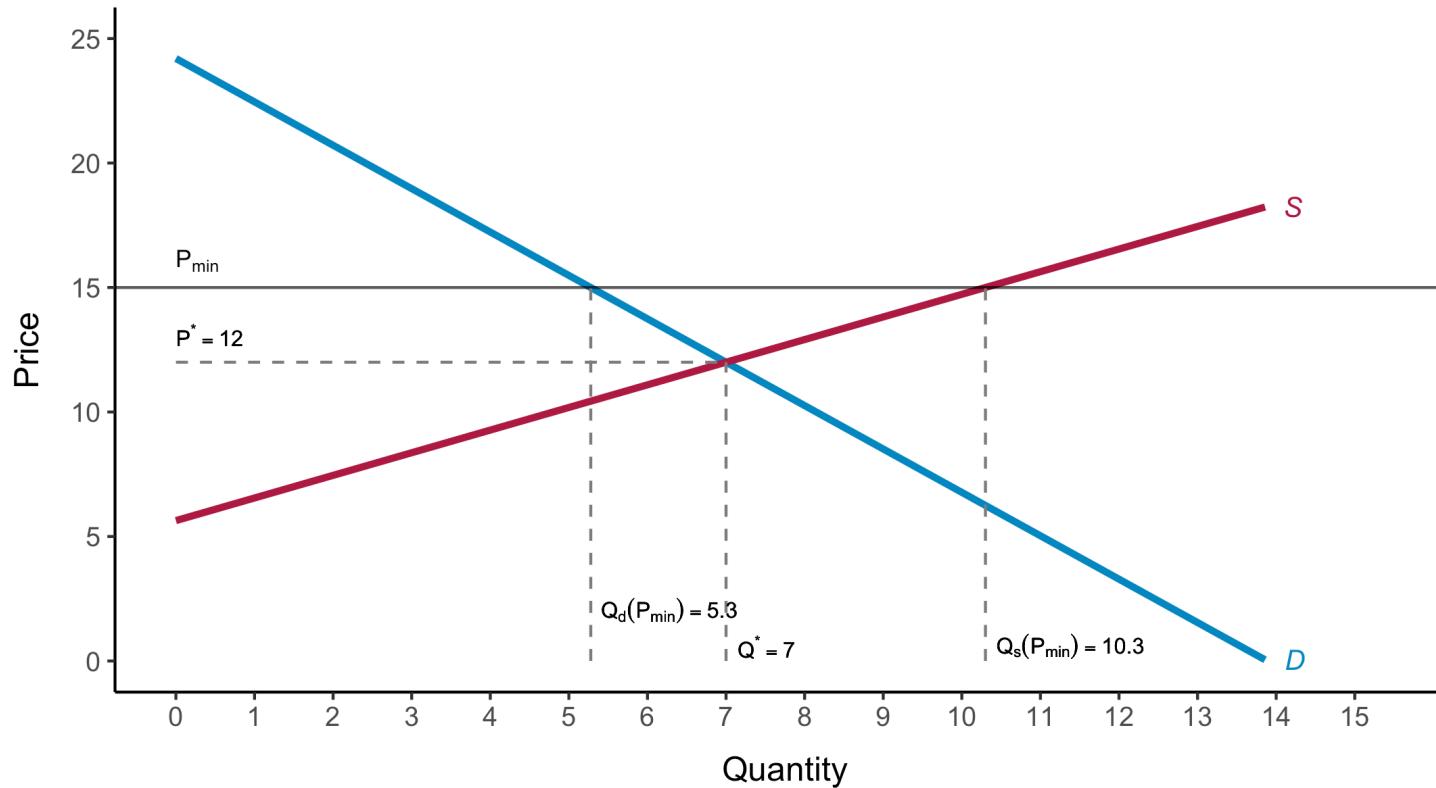


Minimum Prices



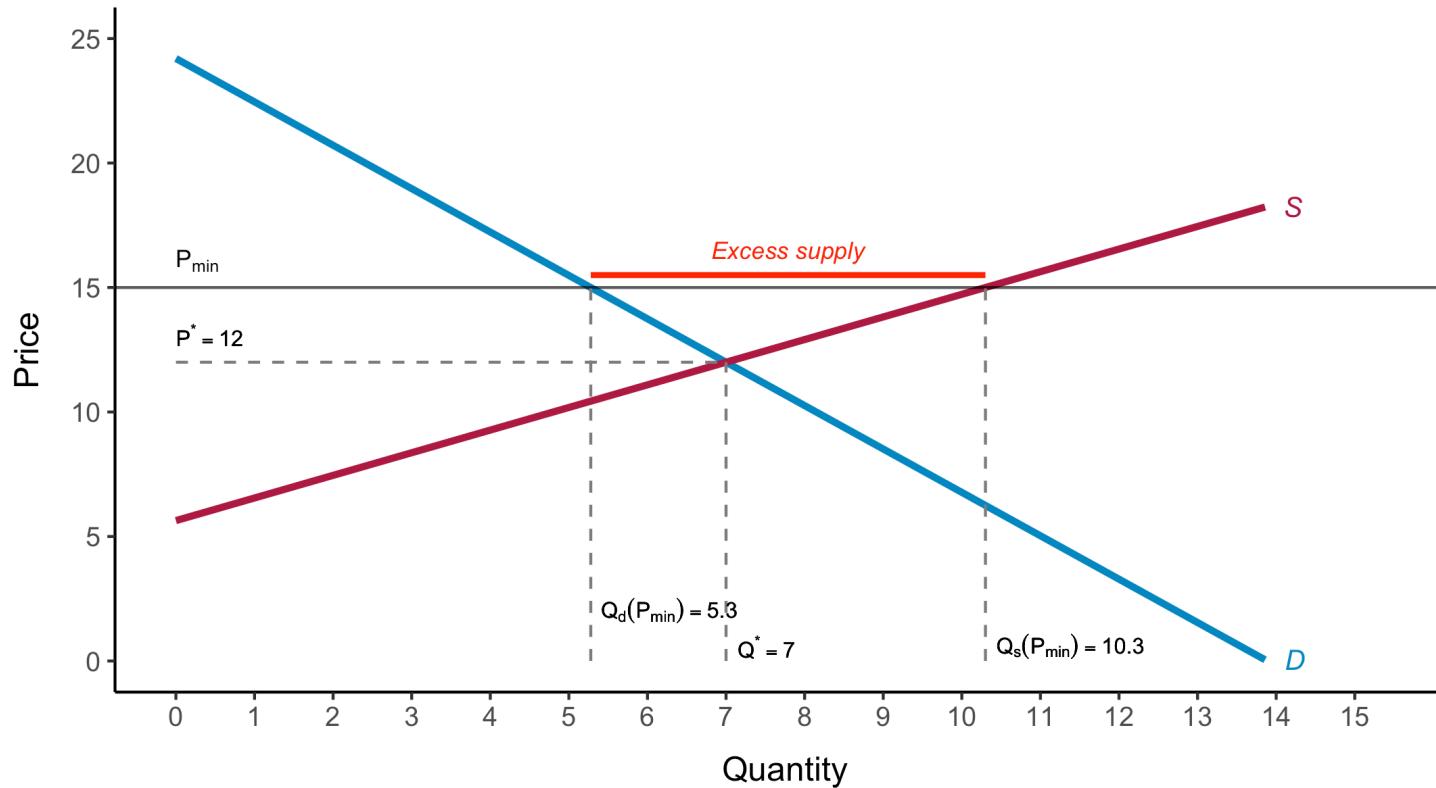
At $P_{min} = 15$, the supply equals ≈ 10.3

Minimum Prices



At $P_{min} = 15$, the demand equals ≈ 5.3

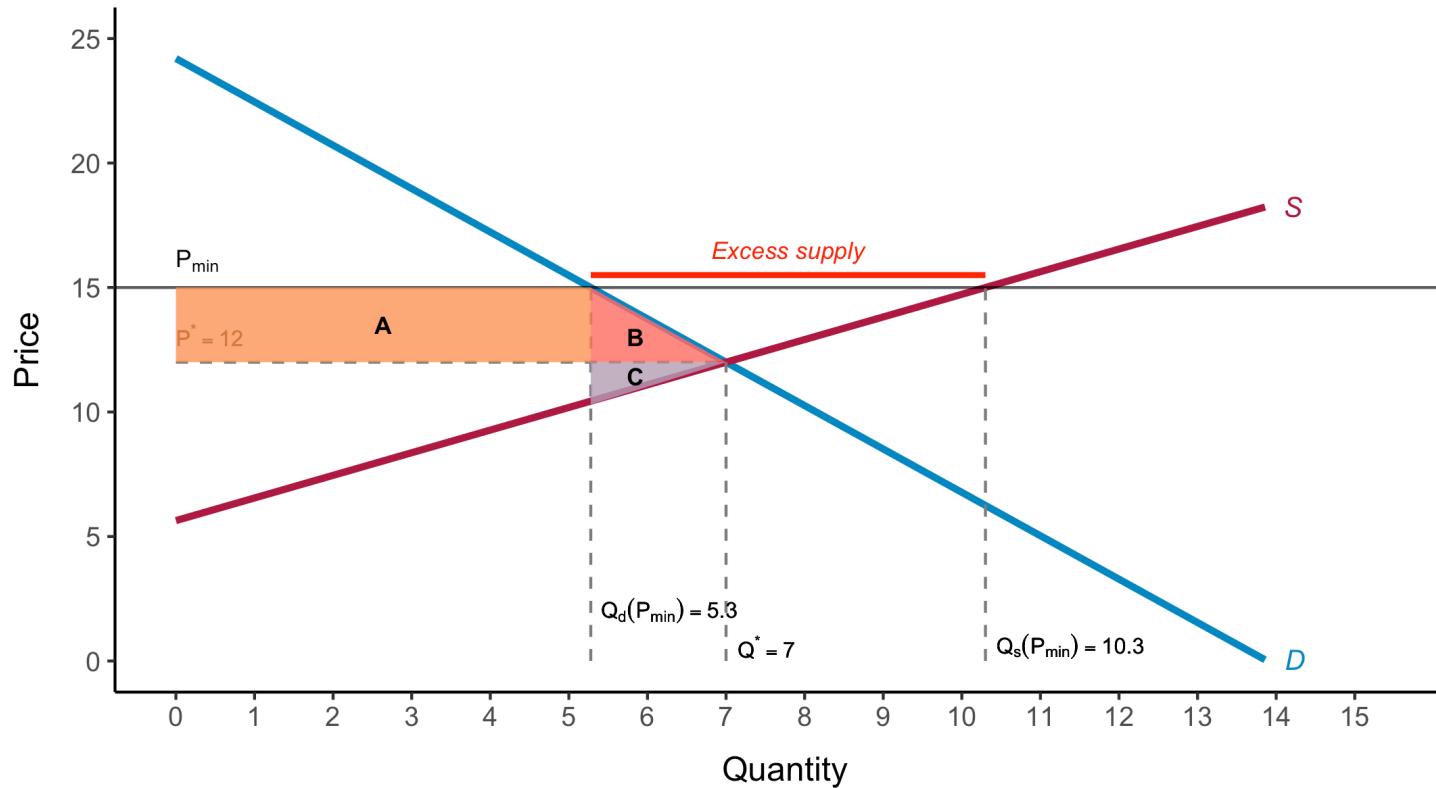
Minimum Prices



At $P_{min} = 15$, the excess supply.

Minimum Prices

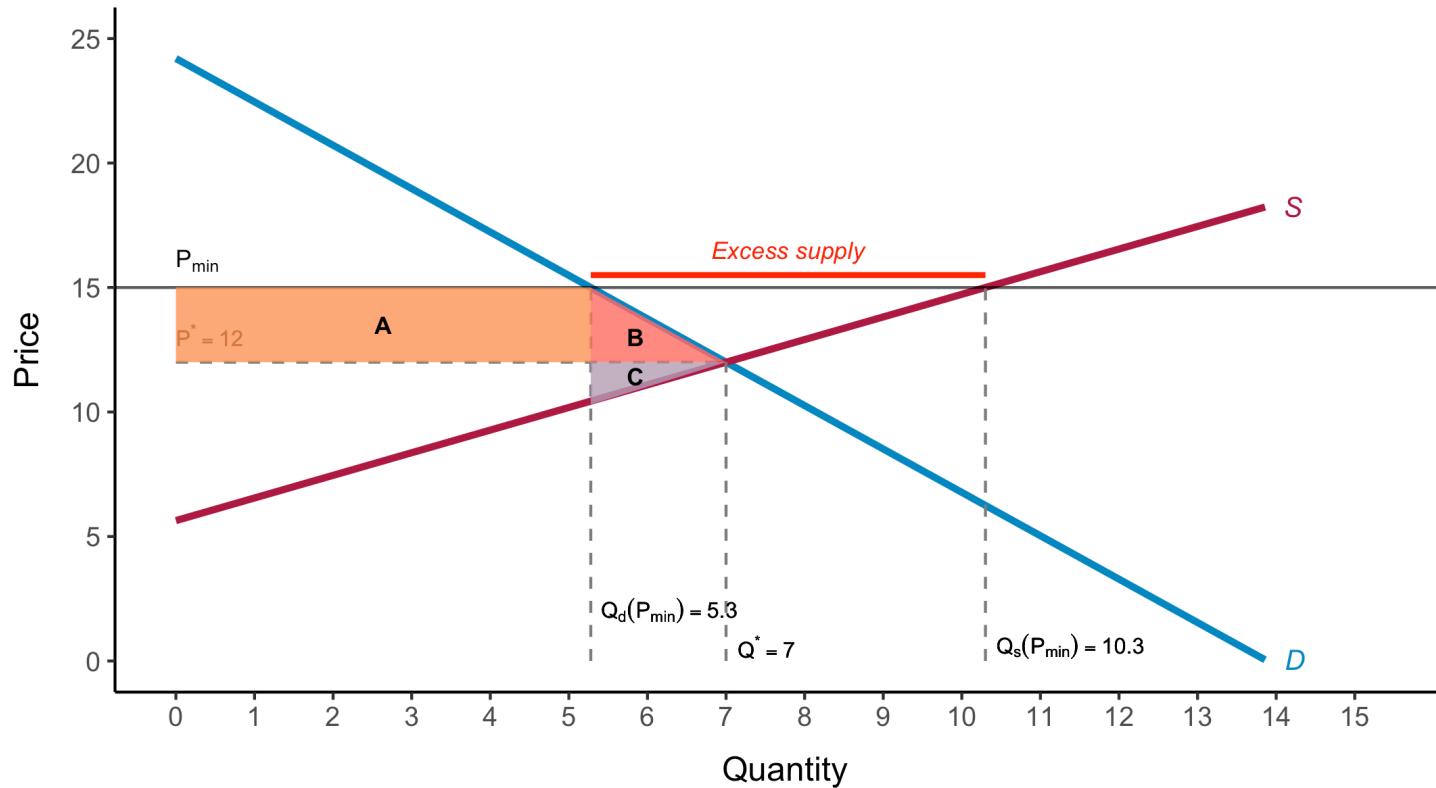
Change in Consumer Surplus



A: Consumers who still purchase the good must now pay a higher price and so suffer a loss of surplus.

Minimum Prices

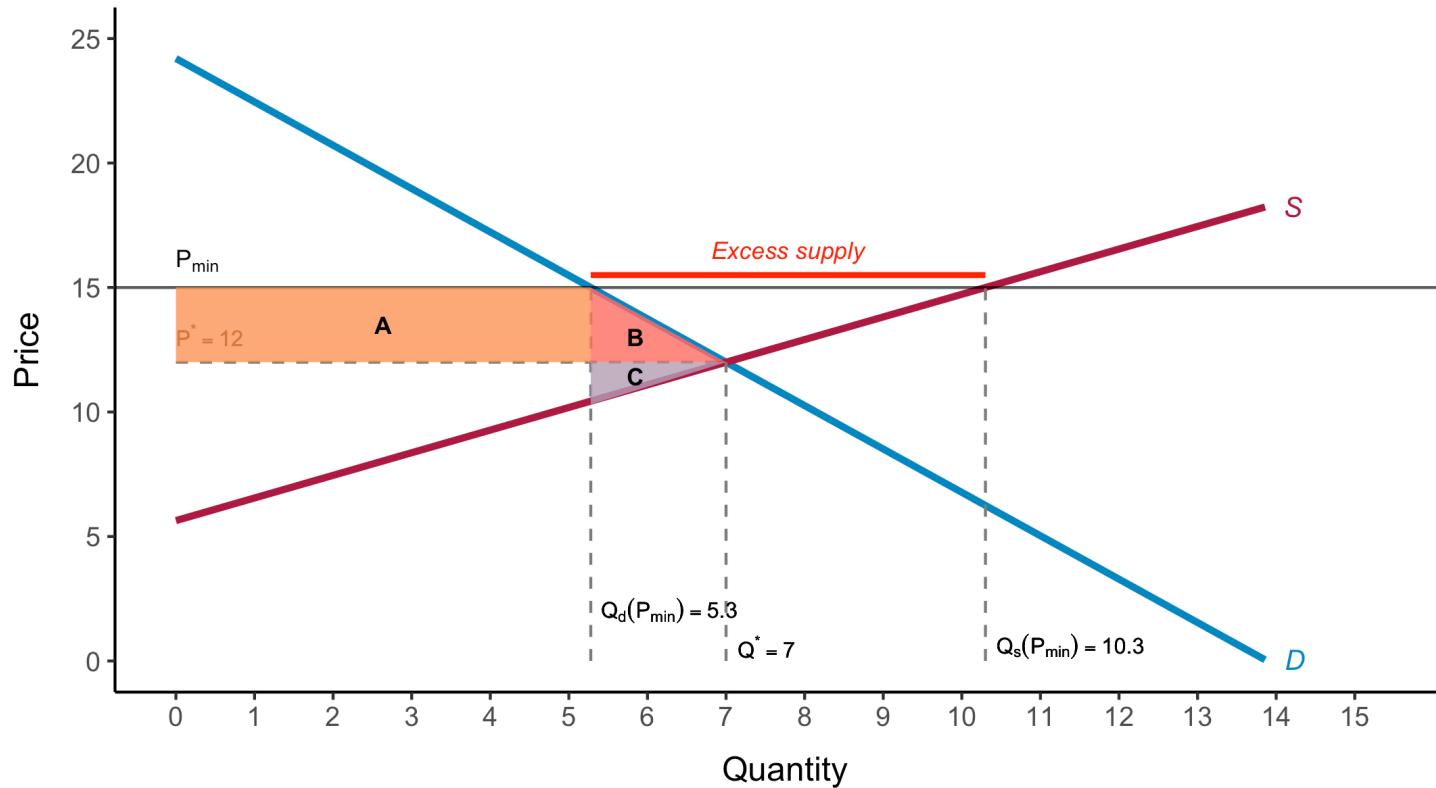
Change in Consumer Surplus



B: Consumers who have dropped out of the market because of the higher price.

Minimum Prices

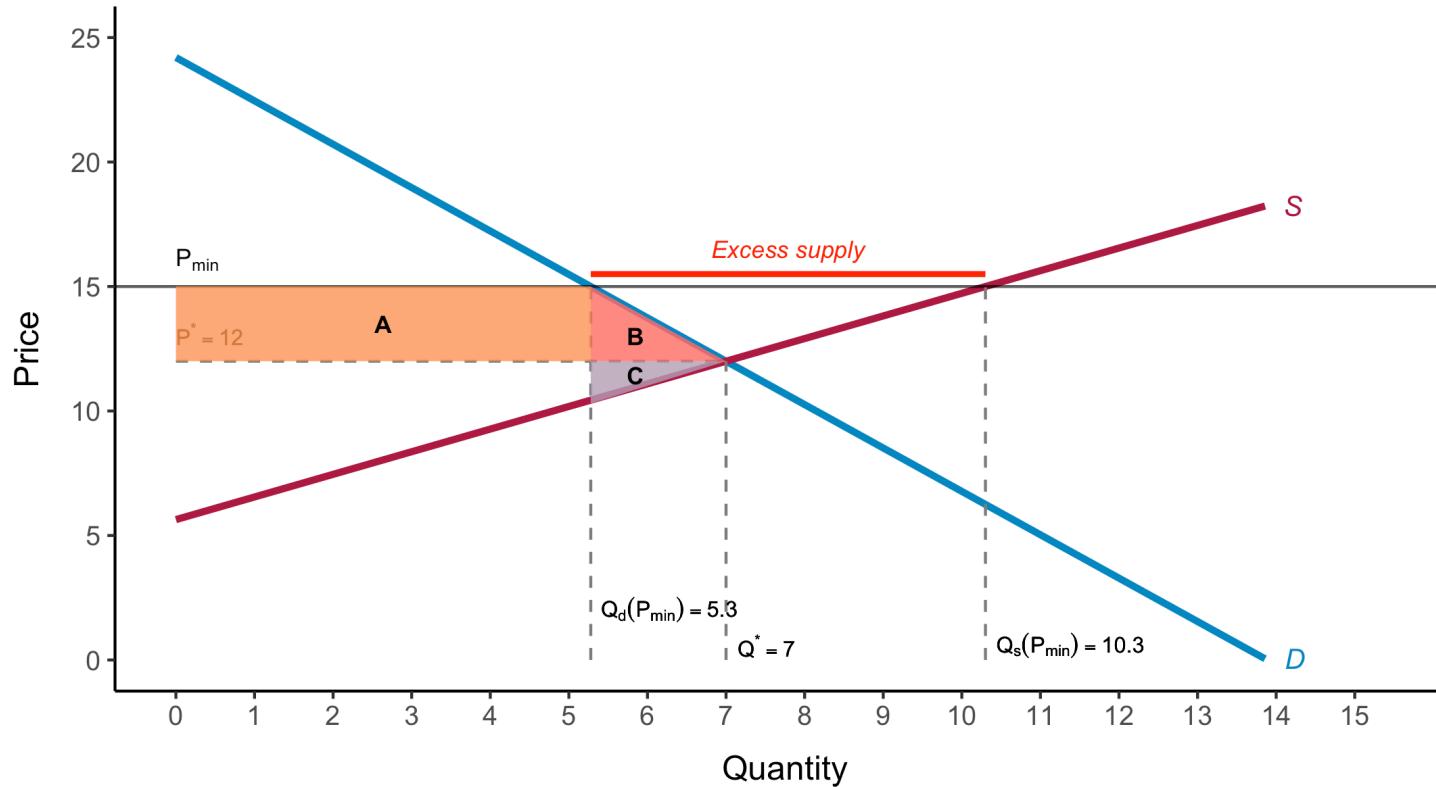
Change in Consumer Surplus



Consumers are worst off: $\Delta CS = -A - B$.

Minimum Prices

Change in Producer Surplus

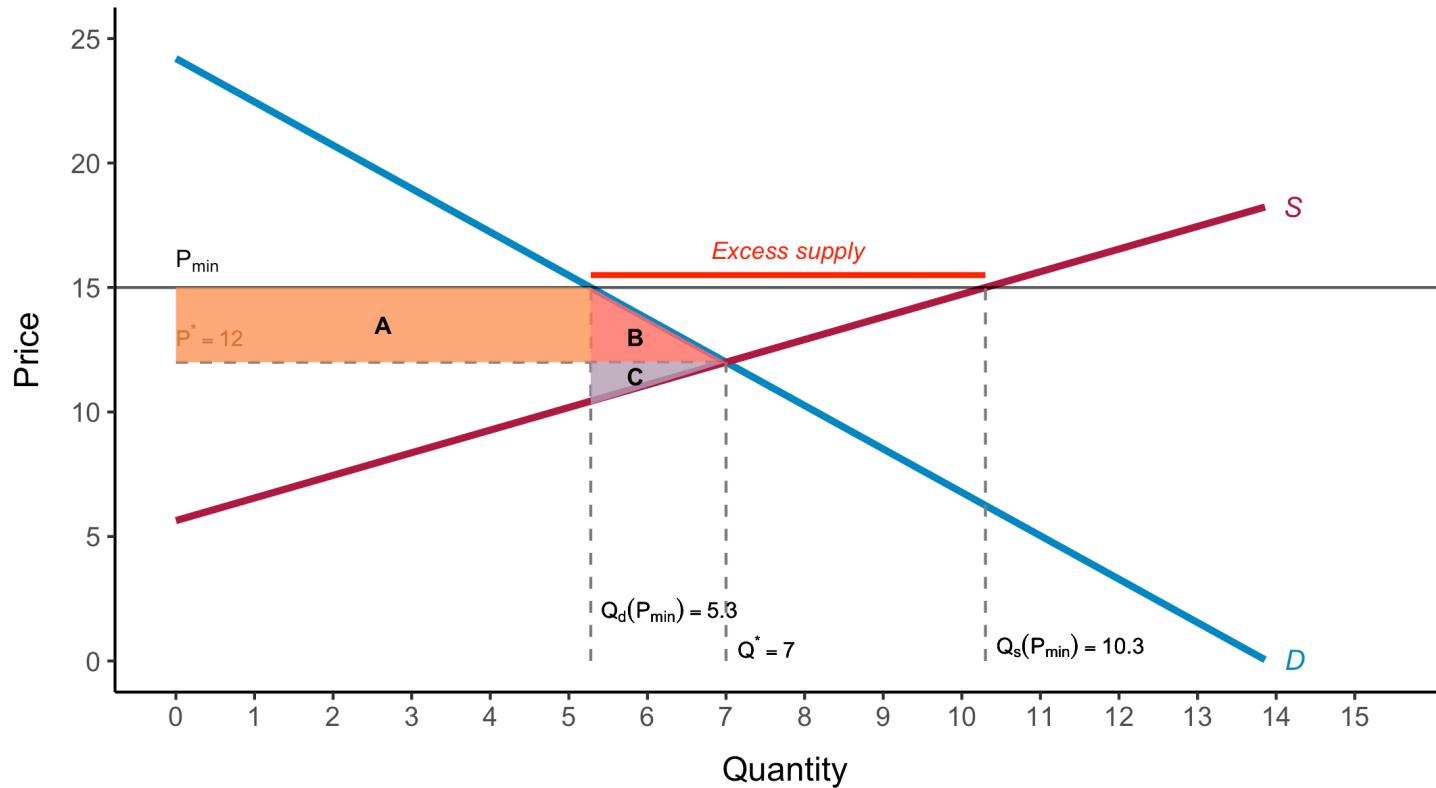


A: Producers who sell receive a higher price for the units they sell → in an increase of surplus.

Transfer from consumers to producers

Minimum Prices

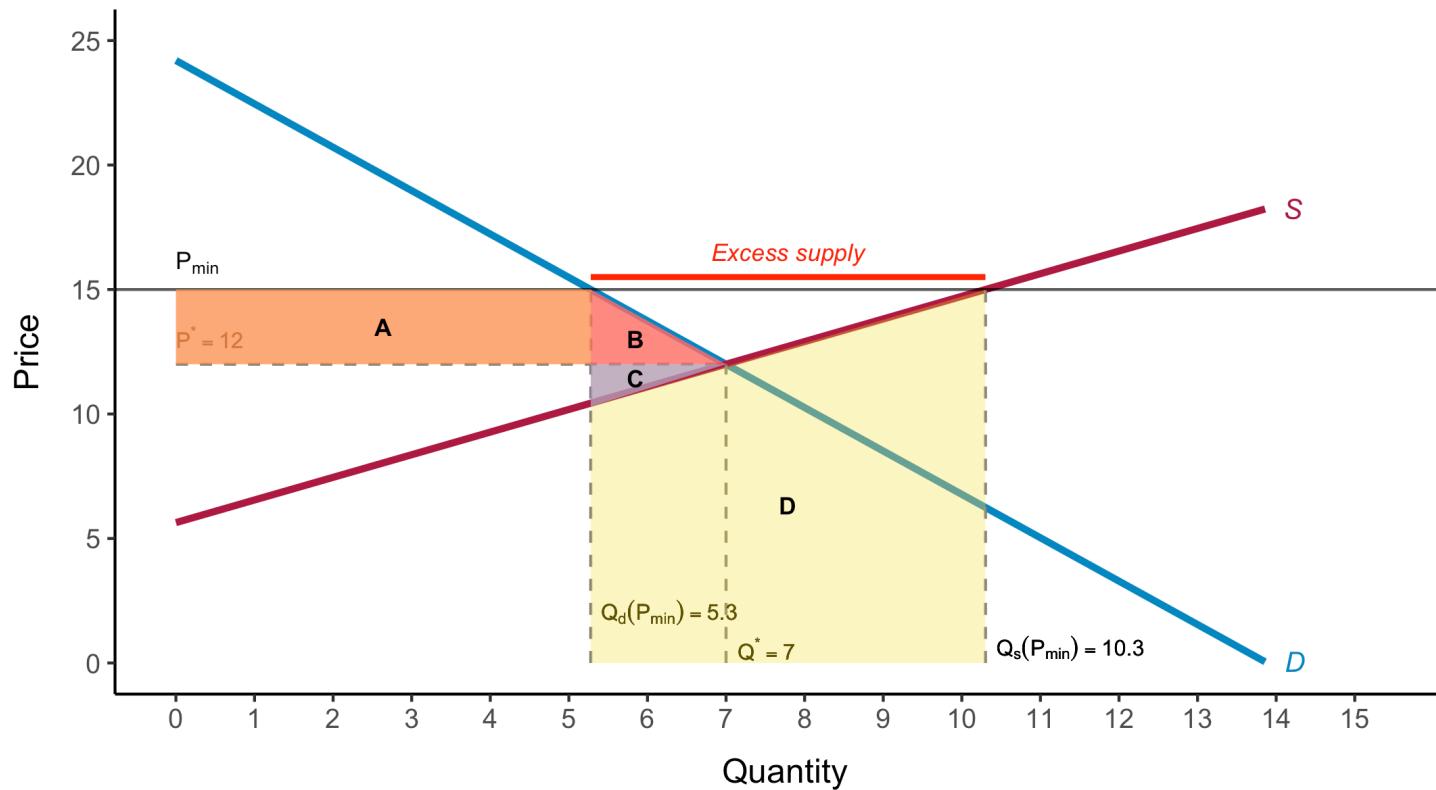
Change in Producer Surplus



C: Drop in sales.

Minimum Prices

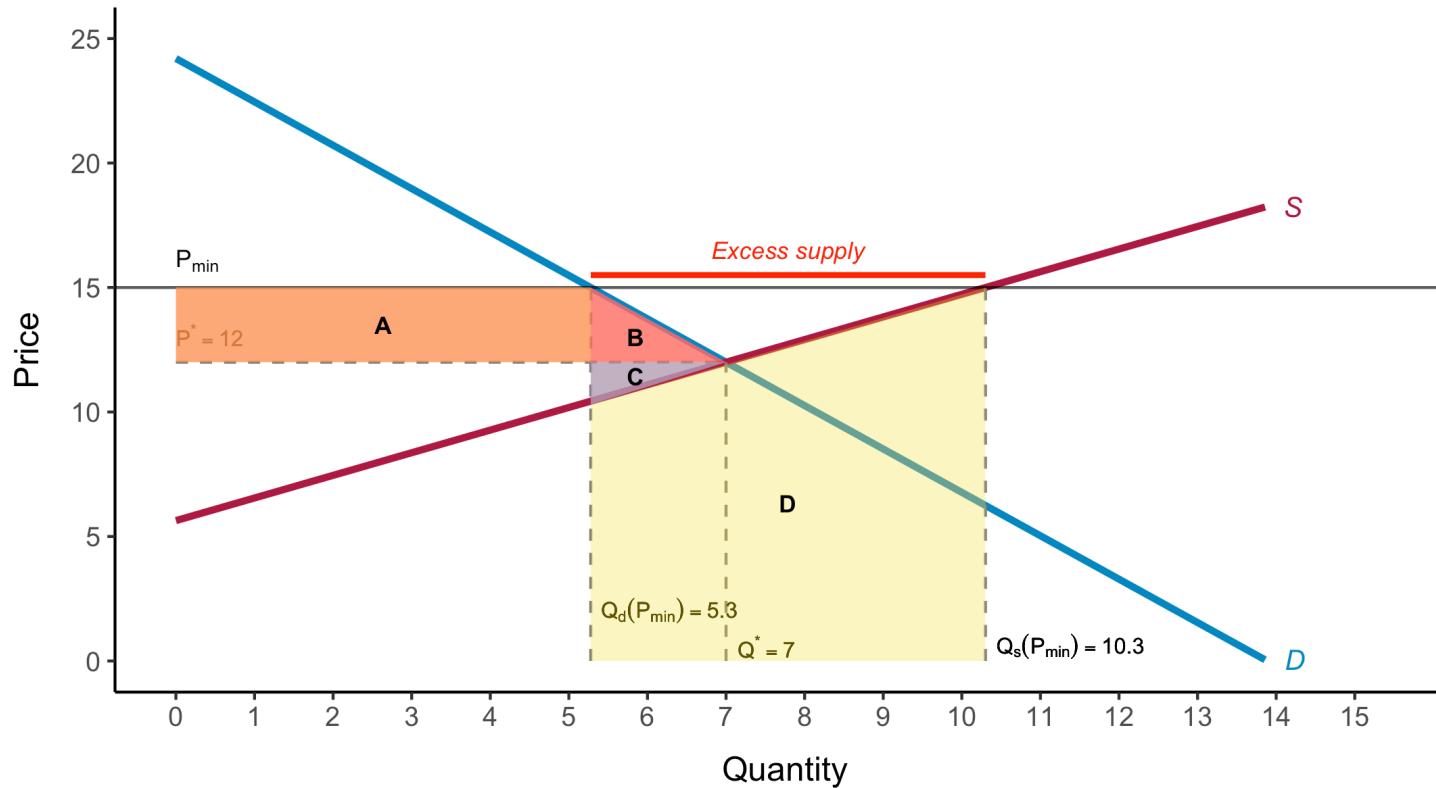
Change in Producer Surplus



D: Cost of producing the quantity $Q_d(P_{min}) - Q_s(P_{min})$

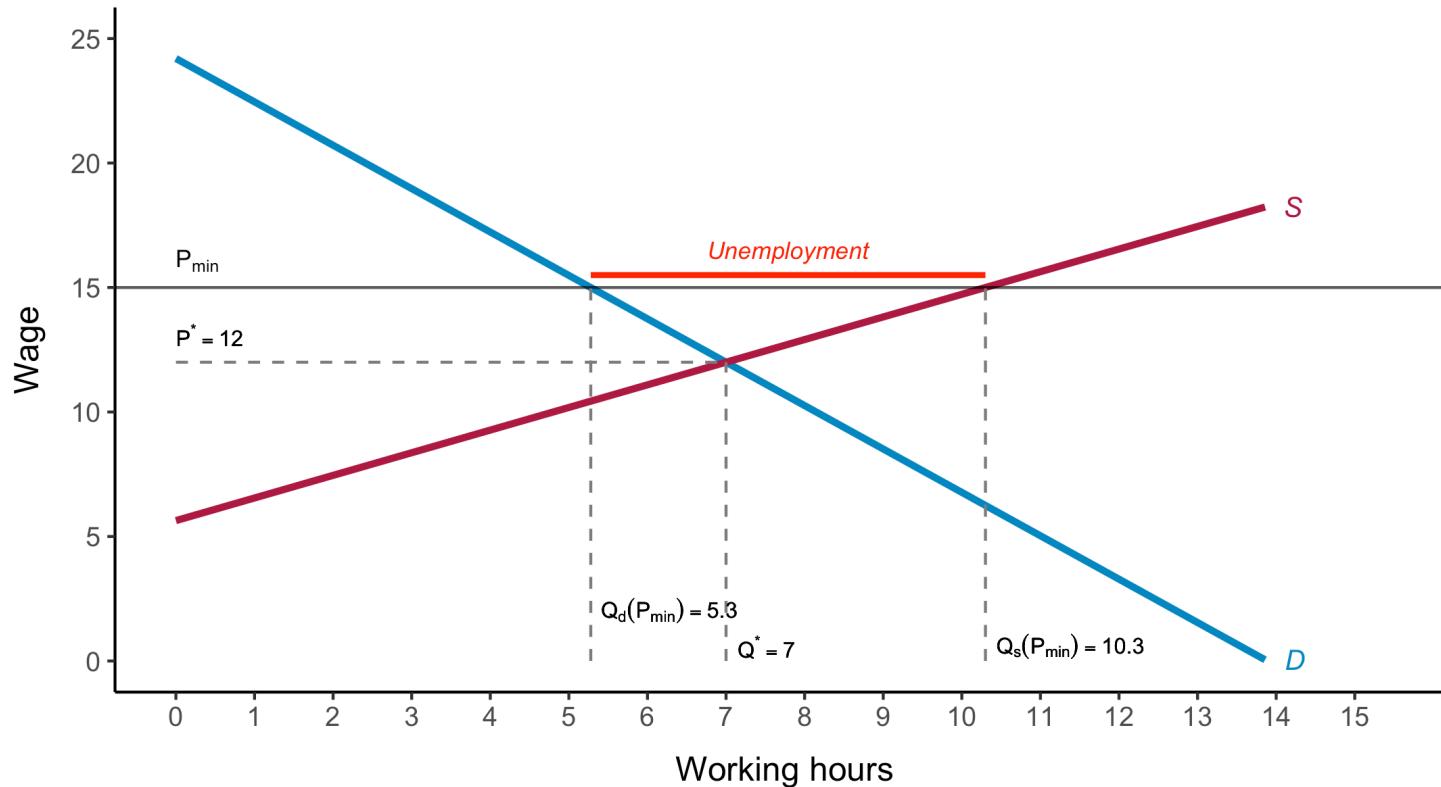
Minimum Prices

Change in Producer Surplus



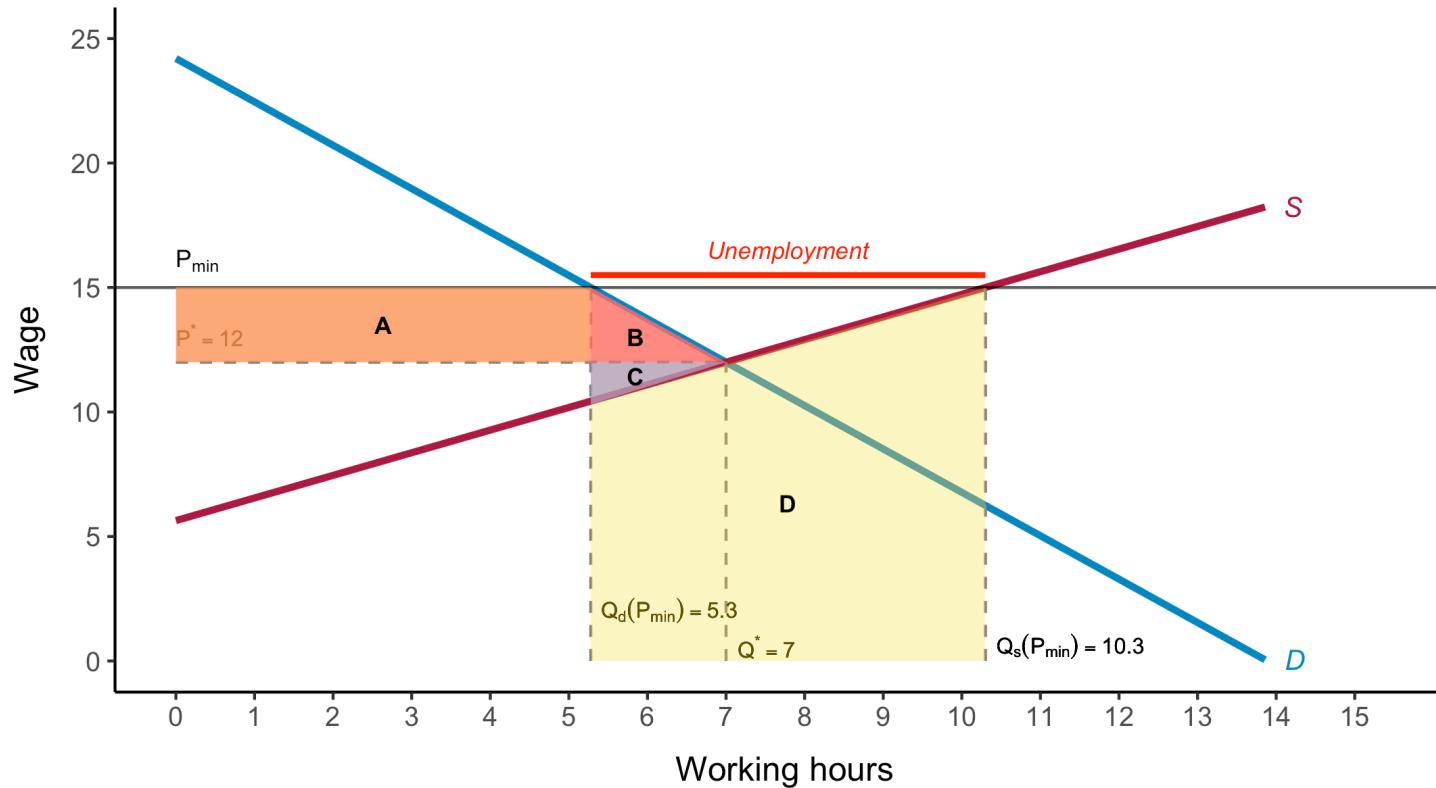
If producers supply $Q_s(P_{min})$, they are worst off: $\Delta PS = A - C - D$

Minimum Prices: Minimum wages



$$\text{Working Hours}_d = 24.2 - 1.74 \cdot w, \quad \text{Working Hours}_s = 5.64 + 0.909 \cdot w$$

Minimum Prices: Minimum wages



Minimum wages: What happens in reality?

Difficult question, as in the real world we cannot make a lab-experiment to increase the minimum wage. However, economics have come with ways to tackle these questions.

See for instance the work on natural experiments from the [2021 Nobel Laureates: David Card, Joshua Angrist and Guido Imbens](#).

Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania

By DAVID CARD AND ALAN B. KRUEGER*

On April 1, 1992, New Jersey's minimum wage rose from \$4.25 to \$5.05 per hour. To evaluate the impact of the law we surveyed 410 fast-food restaurants in New Jersey and eastern Pennsylvania before and after the rise. Comparisons of employment growth at stores in New Jersey and Pennsylvania (where the minimum wage was constant) provide simple estimates of the effect of the higher minimum wage. We also compare employment changes at stores in New Jersey that were initially paying high wages (above \$5) to the changes at lower-wage stores. We find no indication that the rise in the minimum wage reduced employment. (JEL J30, J23)

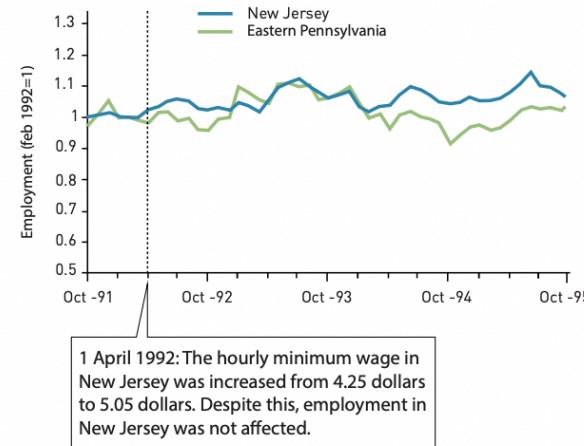
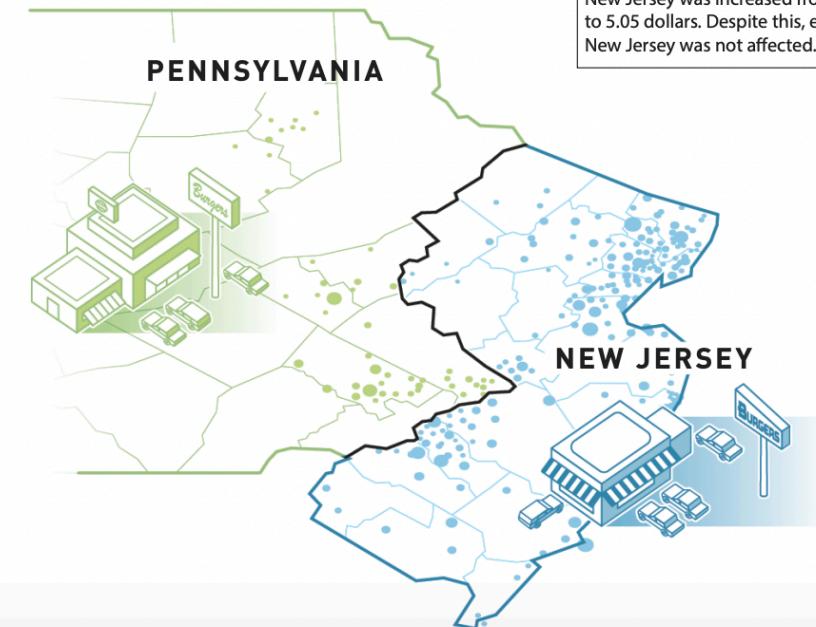
Minimum wages: What happens in reality?

The effect of increasing the minimum wage

Card and Krueger used a natural experiment to study how increasing the minimum wage affects employment.

The researchers identified a treatment group (restaurants in New Jersey) and a control group (restaurants in eastern Pennsylvania) to measure the effect of increasing the minimum wage.

● CONTROL GROUP ● TREATMENT GROUP



Minimum wages: What happens in reality?

THE EFFECT OF MINIMUM WAGES ON LOW-WAGE JOBS*

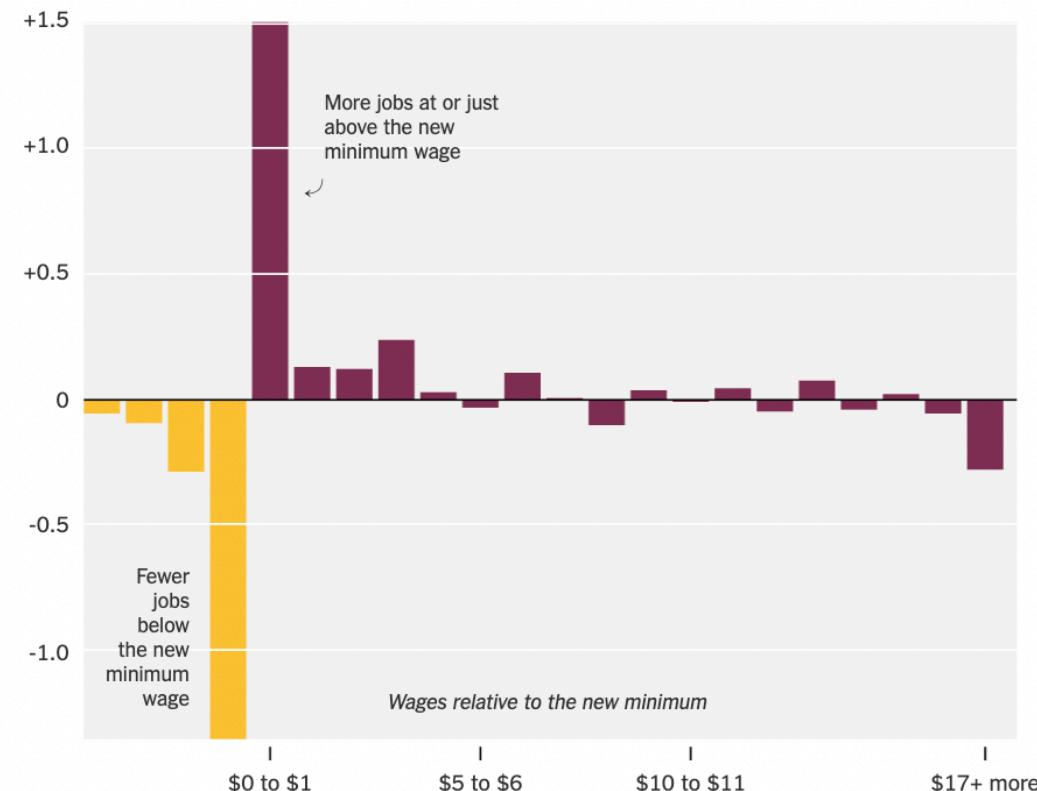
DORUK CENGIZ
ARINDRAJIT DUBE
ATTILA LINDNER
BEN ZIPPERER

We estimate the effect of minimum wages on low-wage jobs using 138 prominent state-level minimum wage changes between 1979 and 2016 in the United States using a difference-in-differences approach. We first estimate the effect of the minimum wage increase on employment changes by wage bins throughout the hourly wage distribution. We then focus on the bottom part of the wage distribution and compare the number of excess jobs paying at or slightly above the new minimum wage to the missing jobs paying below it to infer the employment effect. We find that the overall number of low-wage jobs remained essentially unchanged over the five years following the increase. At the same time, the direct effect of the minimum wage on average earnings was amplified by modest wage spillovers at the bottom of the wage distribution. Our estimates by detailed demographic groups show that the lack of job loss is not explained by labor-labor substitution at the bottom of the wage distribution. We also find no evidence of disemployment when we consider higher levels of minimum wages. However, we do find some evidence of reduced employment in tradeable sectors. We also show how decomposing the overall employment effect by wage bins allows a transparent way of assessing the plausibility of estimates. *JEL Codes:* J23, J38, J88.

Minimum wages: What happens in reality?

What Research Showed Across the United States

Estimates of the change in jobs five years after a change in the minimum wage, as a share of total employment before the increase

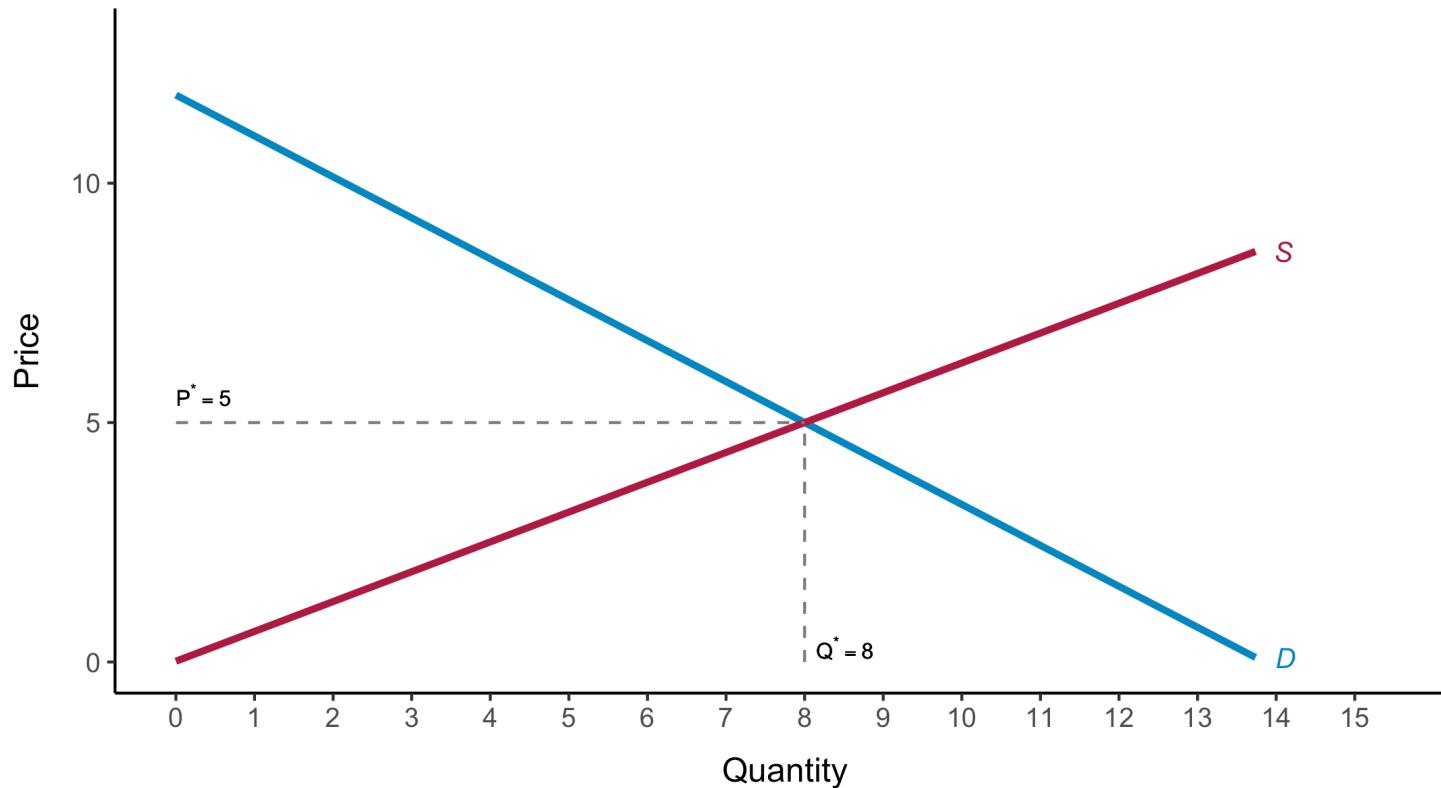


Based on 137 state-level minimum wage increases between 1979 and 2016

Price Supports and Production Quotas

Price supports

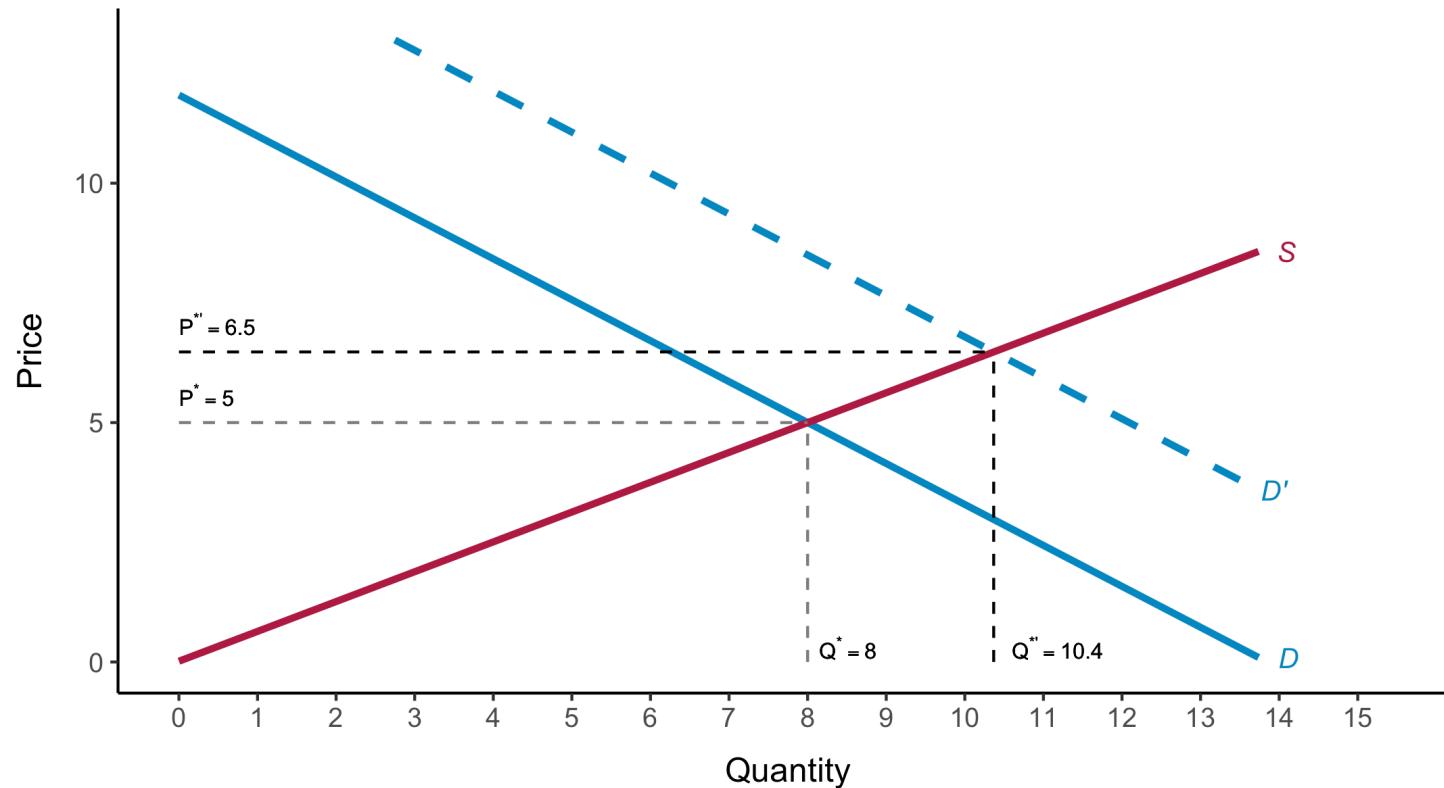
The government sets the market price of a good above the free-market level and buys up whatever output is needed to maintain that price.



$$Q_d = 11.8 - 0.855 \cdot P, \quad Q_s = 0.0155 + 0.623 \cdot P$$

Price supports

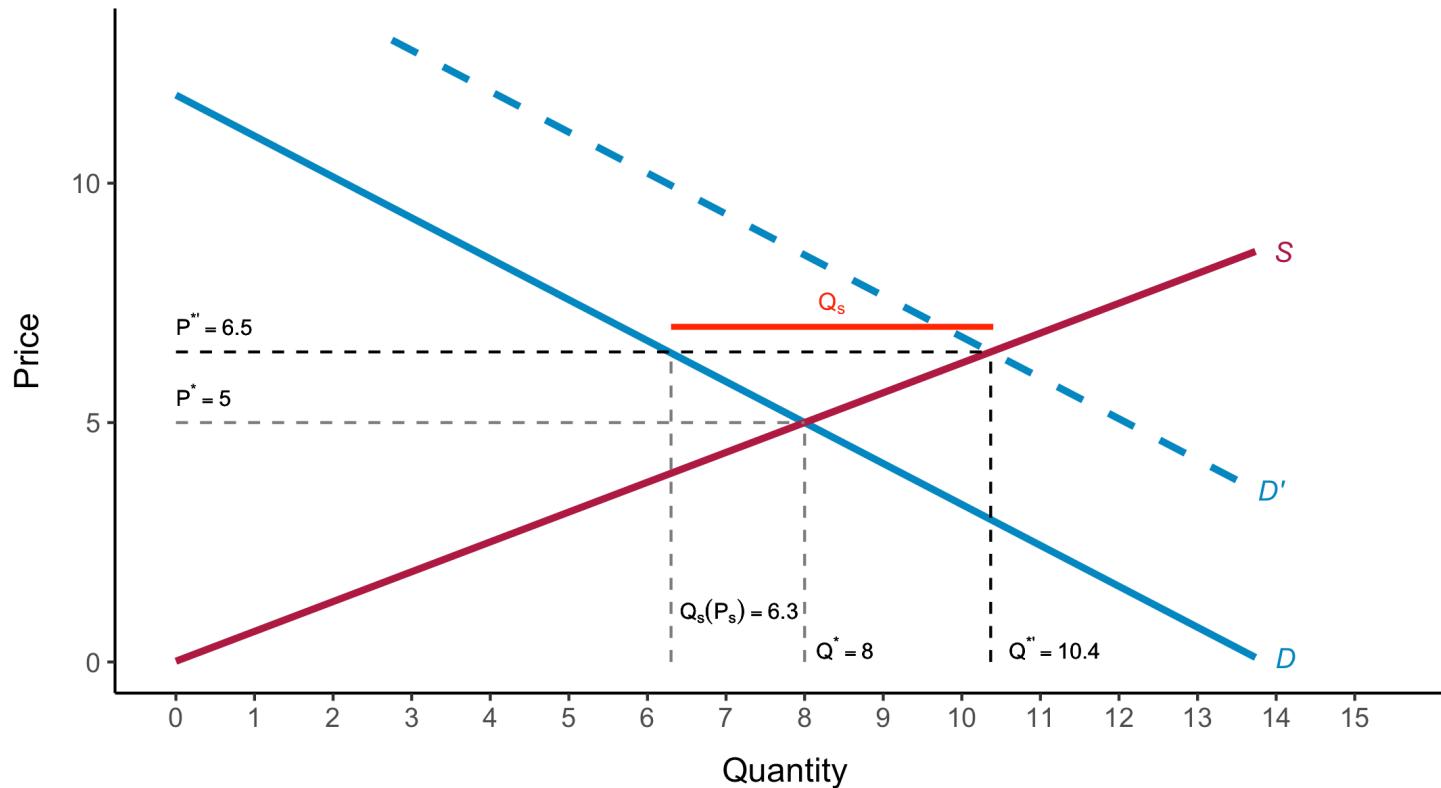
The government sets the market price of a good above the free-market level and buys up whatever output is needed to maintain that price.



Support price: $P^{*'} = 6.5$.

Price supports

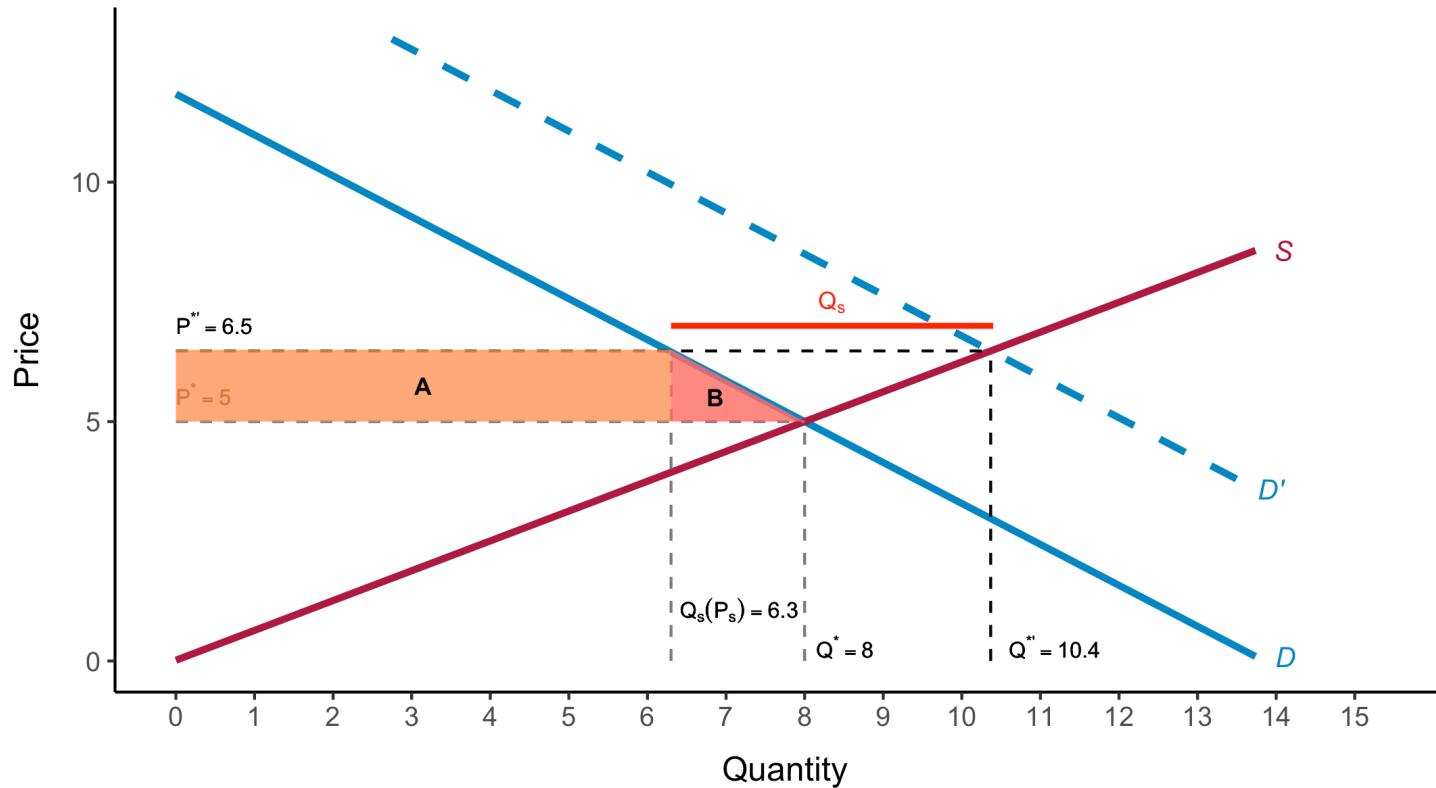
The government sets the market price of a good above the free-market level and buys up whatever output is needed to maintain that price.



At $P^* = 6.5$, $Q_s(P_s) = 6.3$. Thus, the government buys $Q_s = Q^* - Q_s(P_s) = 10.4 - 6.3 = 4.1$.

Price supports

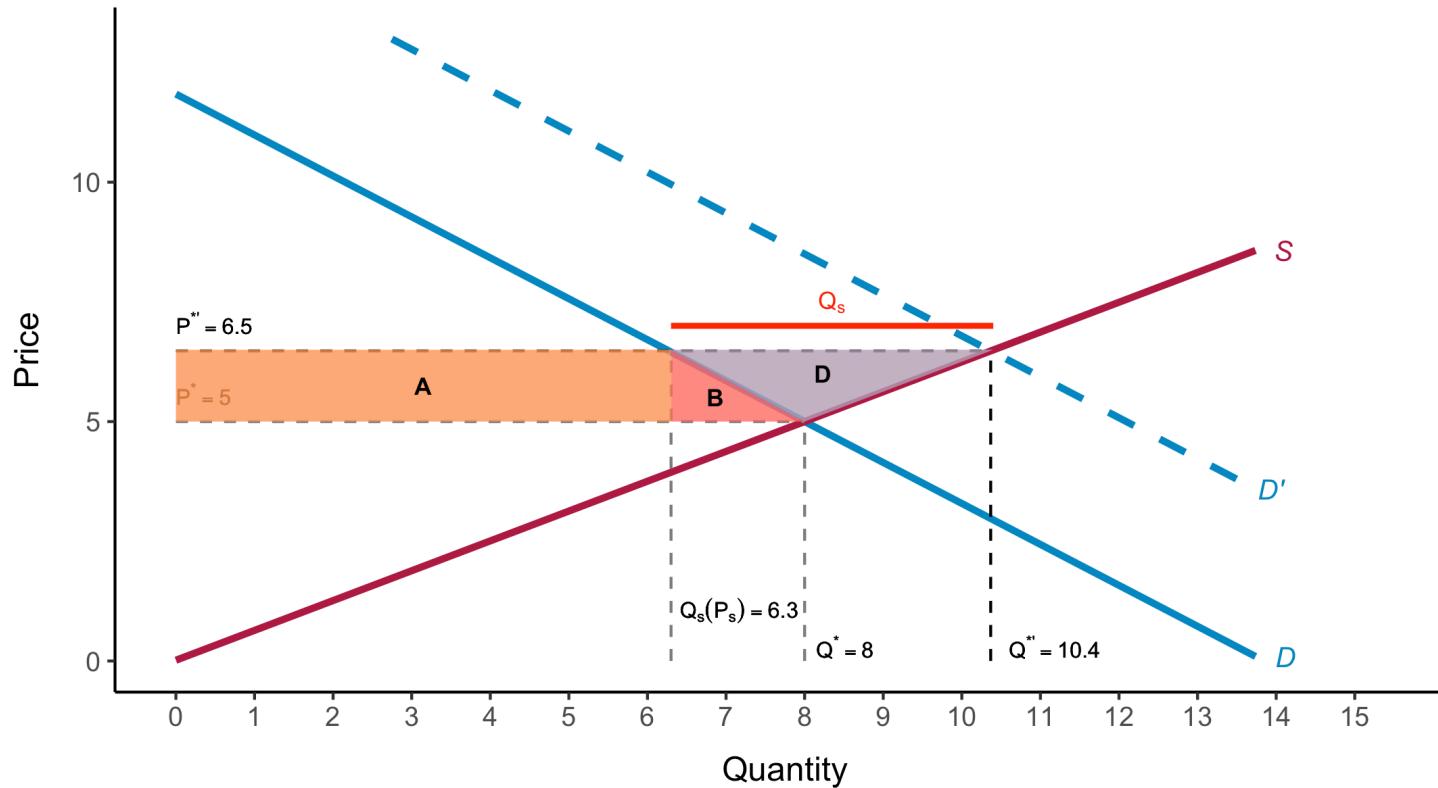
Change in Consumer Surplus: $\Delta CS = -A - B$



A: Consumers who purchase the good must pay the higher price **B:** Consumers who consume less or out of the market

Price supports

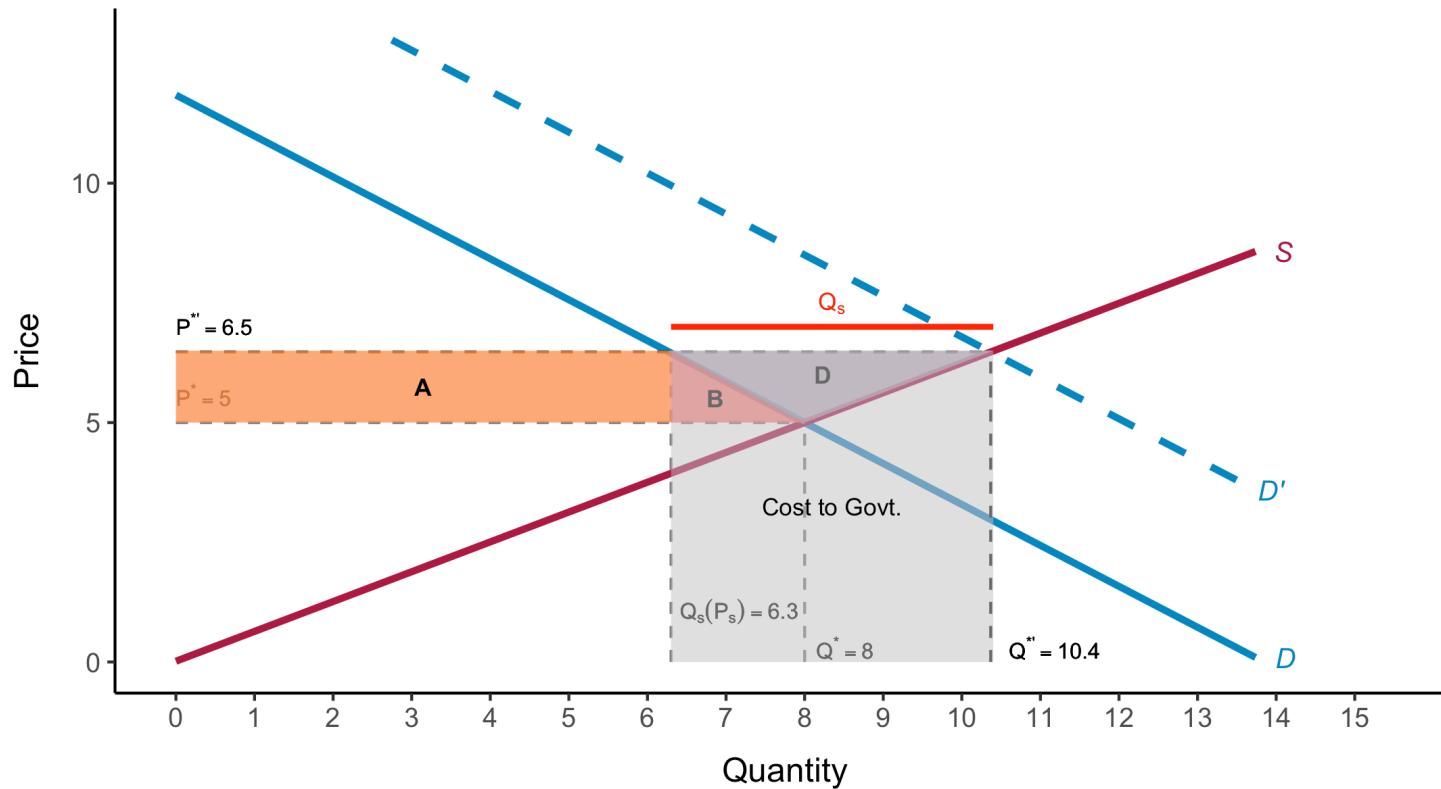
Change in Producer Surplus: $\Delta PS = A + B + D$



A: Transfer from consumers to producers B: Extra payoff for price above the market price D: Payoff from sell to government

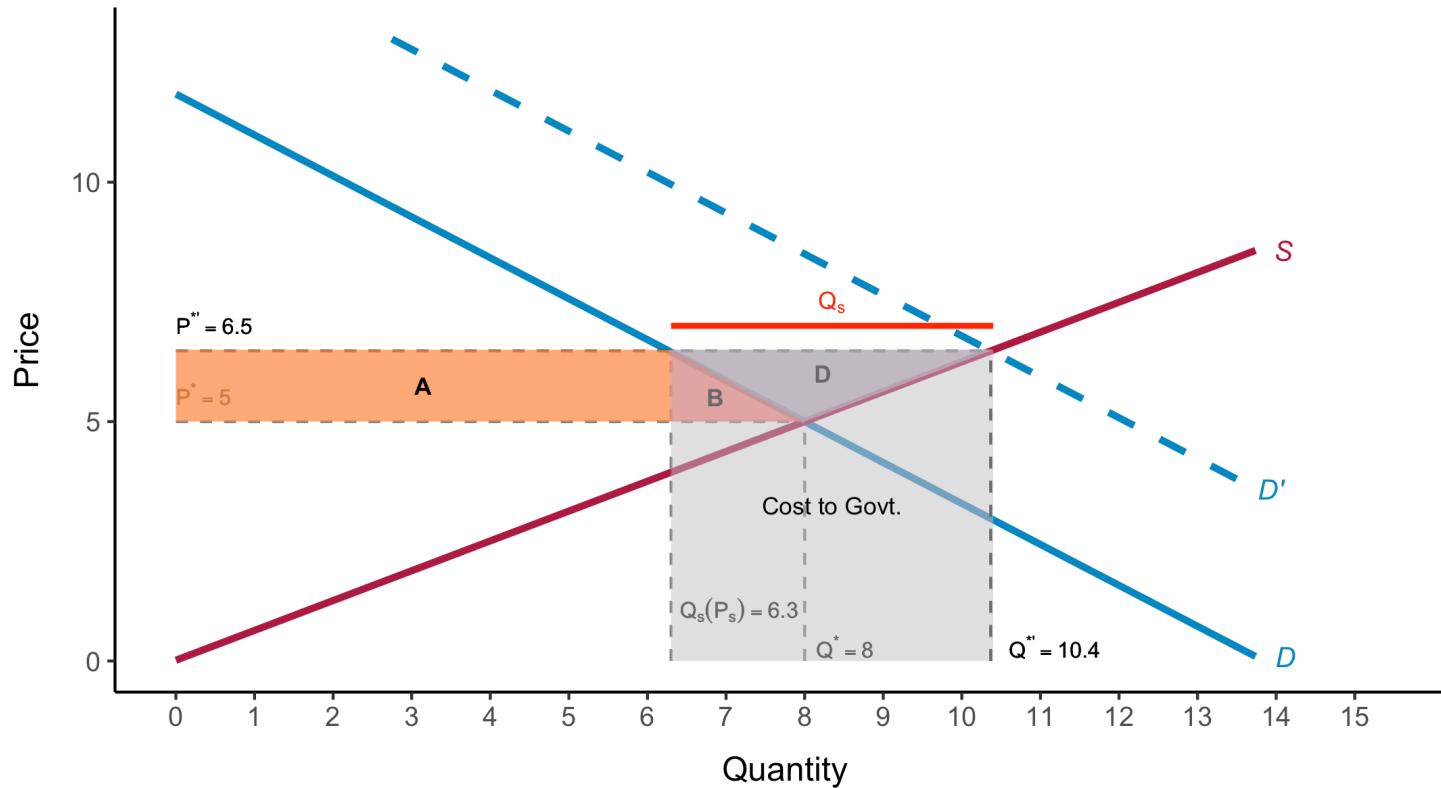
Price supports

Cost to Govt.: $Q_s \cdot P_s$



Price supports

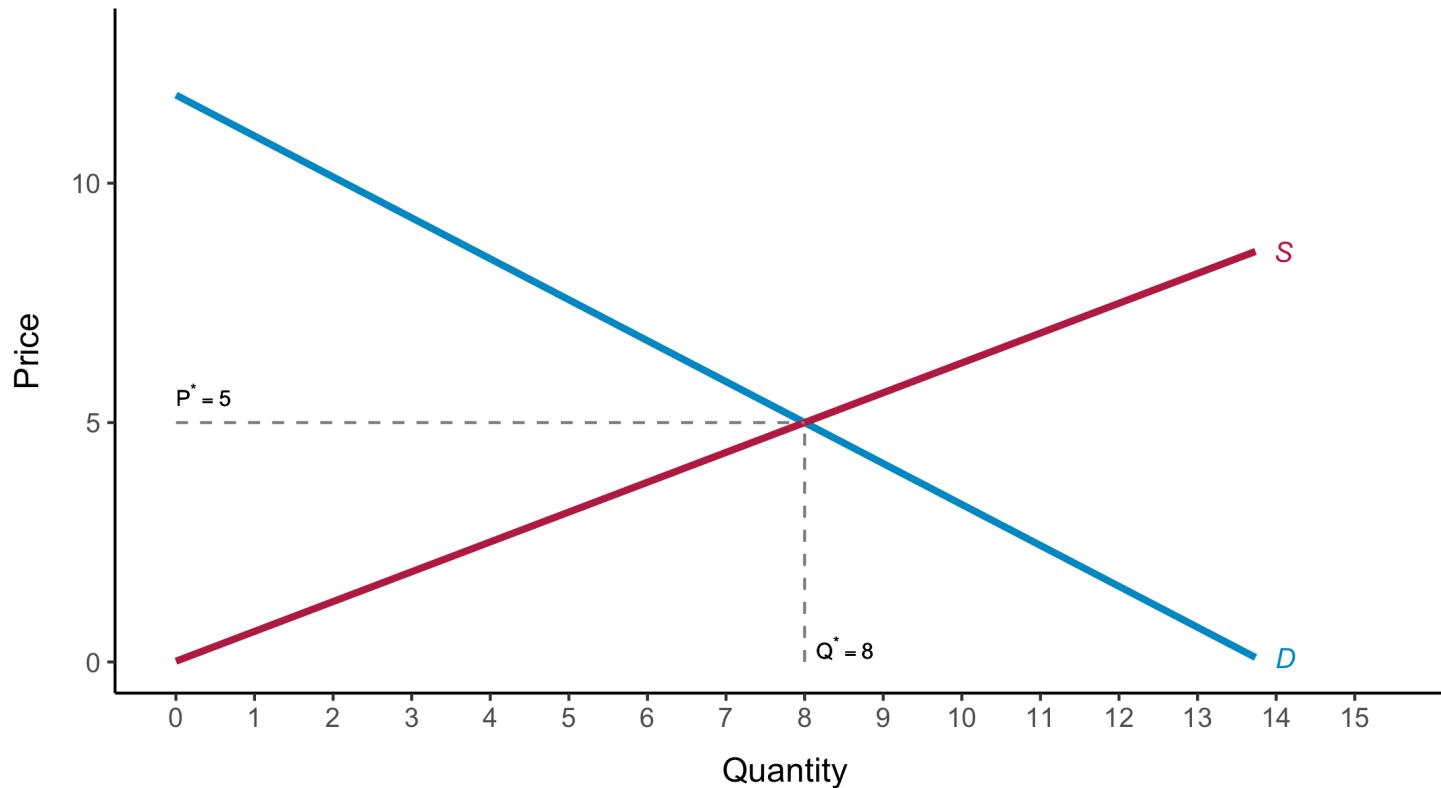
Total change in welfare: $\Delta CS + \Delta PS - Cost. to Govt. = D - Q_s \cdot P_s$



Used in agricultural sector. What do you think is the elasticity of such goods?

Production quotas

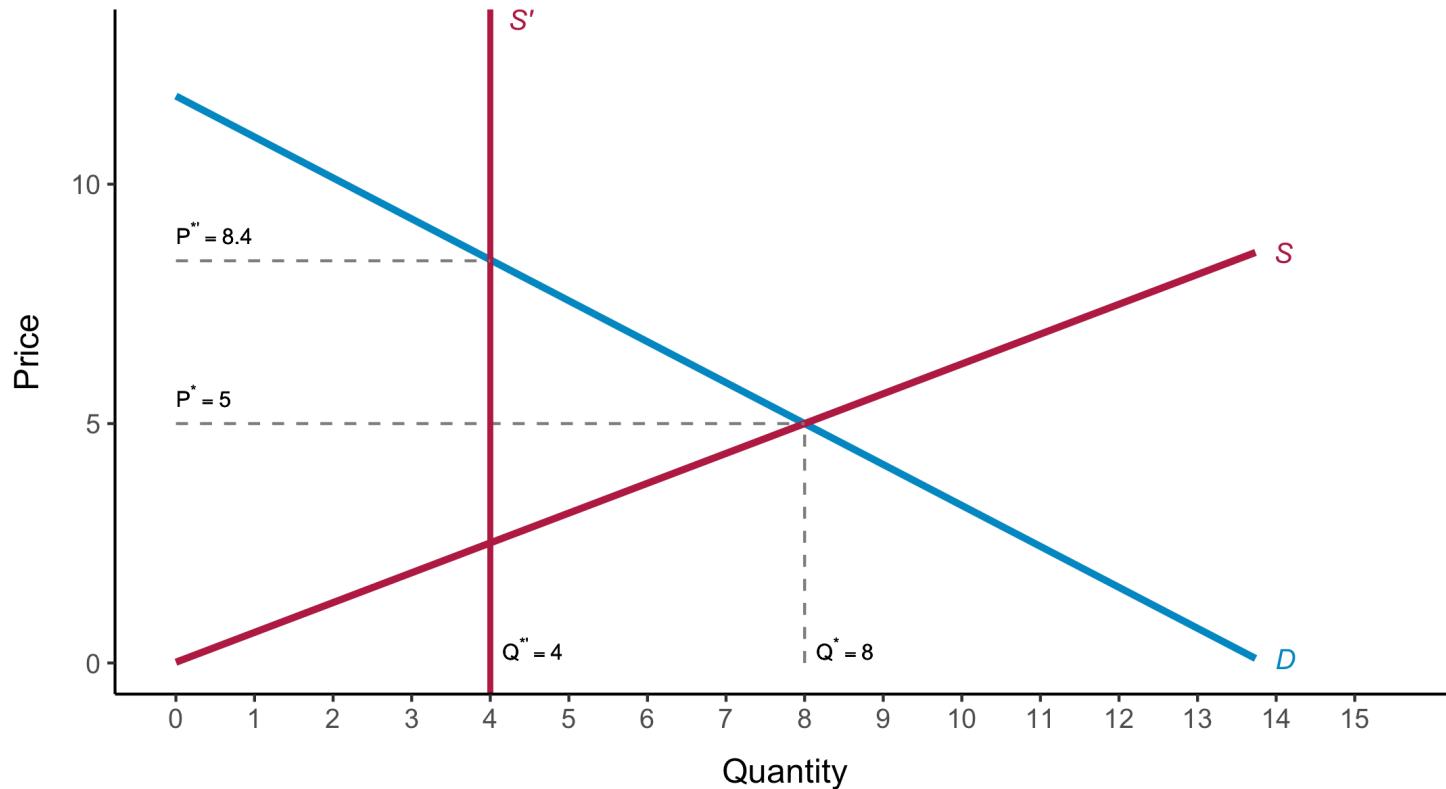
Governments can also increase the price of a good by reducing supply by decree -by setting quotas on how much firms can produce.



$$Q_d = 11.8 - 0.855 \cdot P, \quad Q_s = 0.0155 + 0.623 \cdot P$$

Production quotas

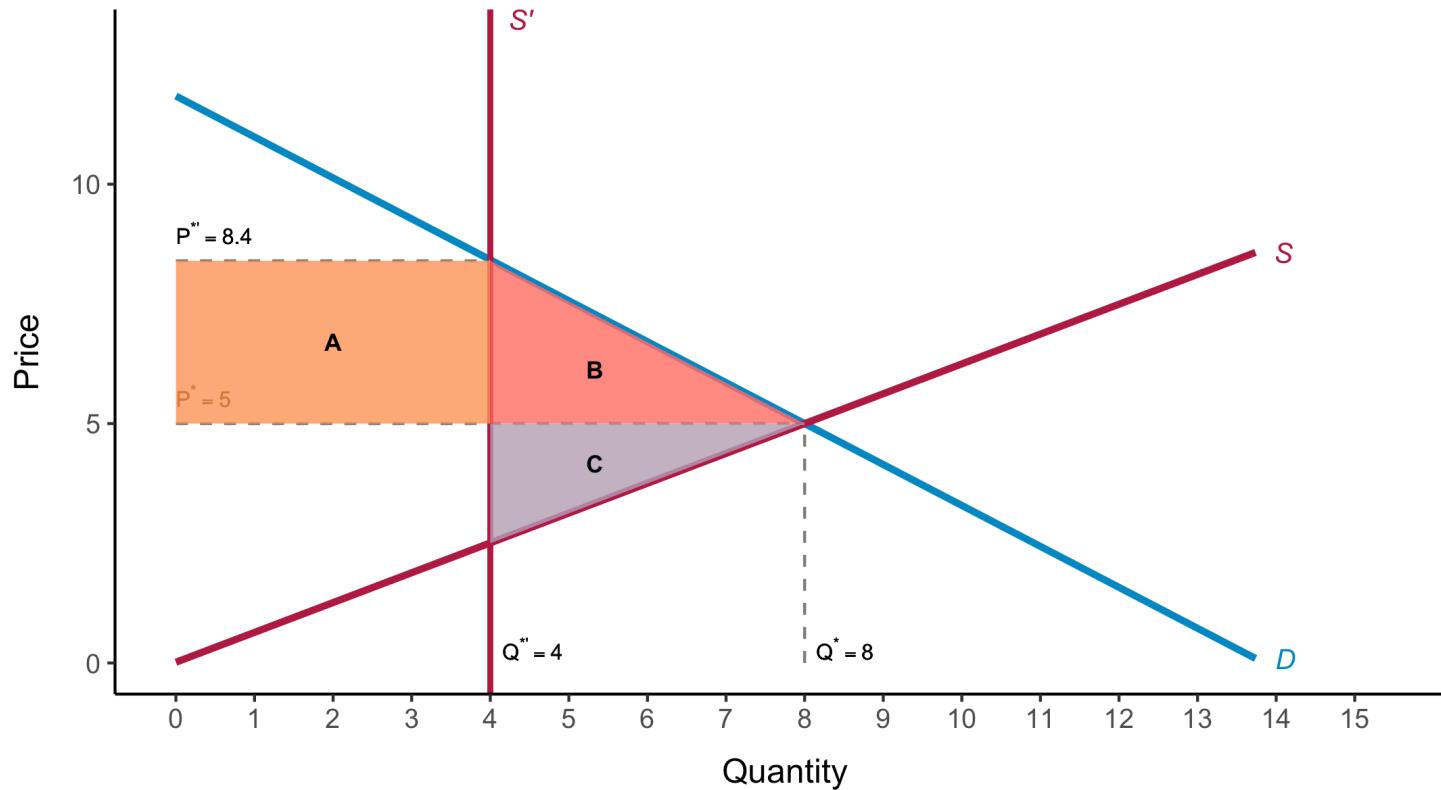
Governments can also increase the price of a good by reducing supply by decree -by setting quotas on how much firms can produce.



Production quotas

Change in Consumer Surplus: $\Delta CS = -A - B$

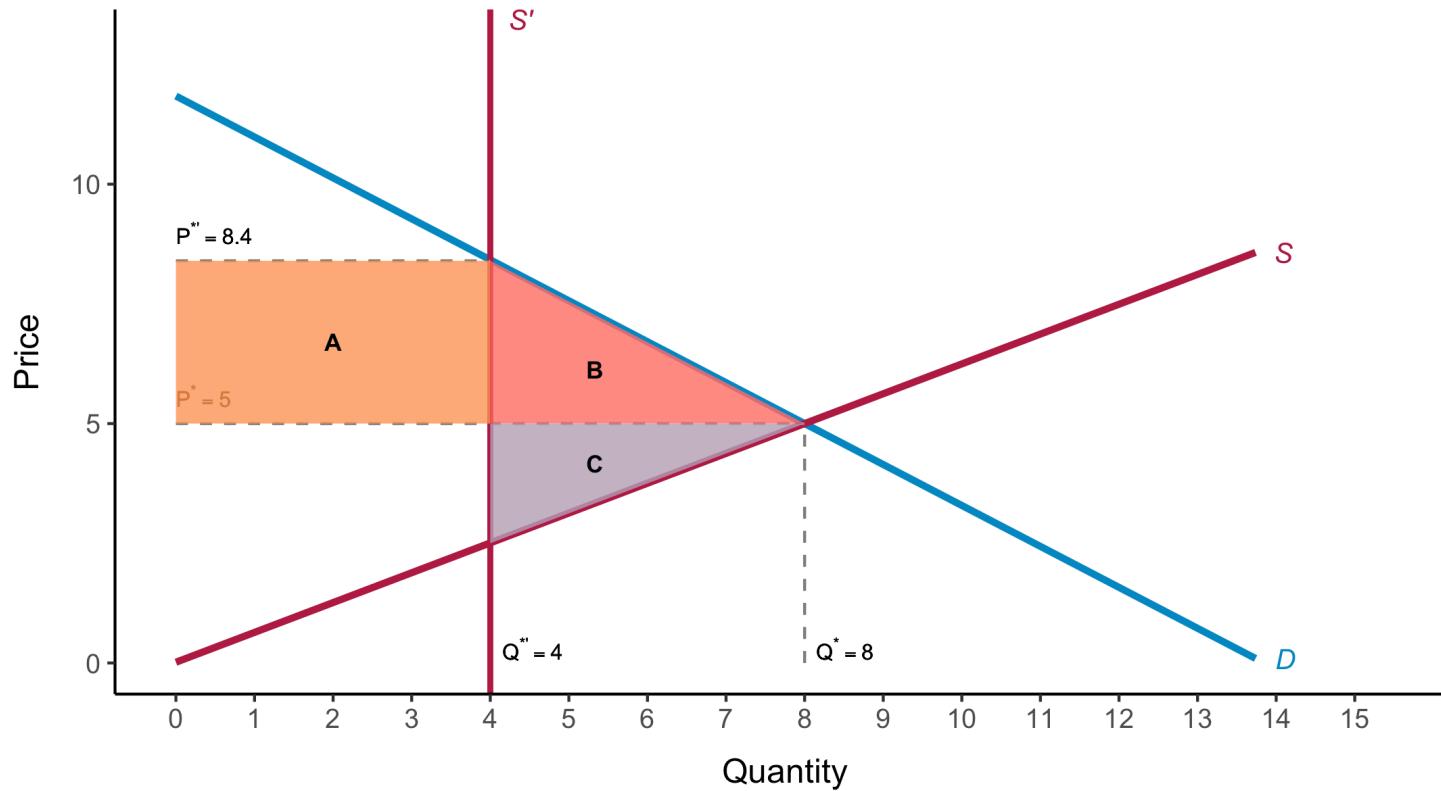
Change in Producer Surplus: $\Delta PS = A - C$



Make an interpretation of which consumers/producers are being represented in each polygon.

Production quotas

Deadweight loss: $\Delta W = -B - C$



Production quotas: Taxi medallions or permits.

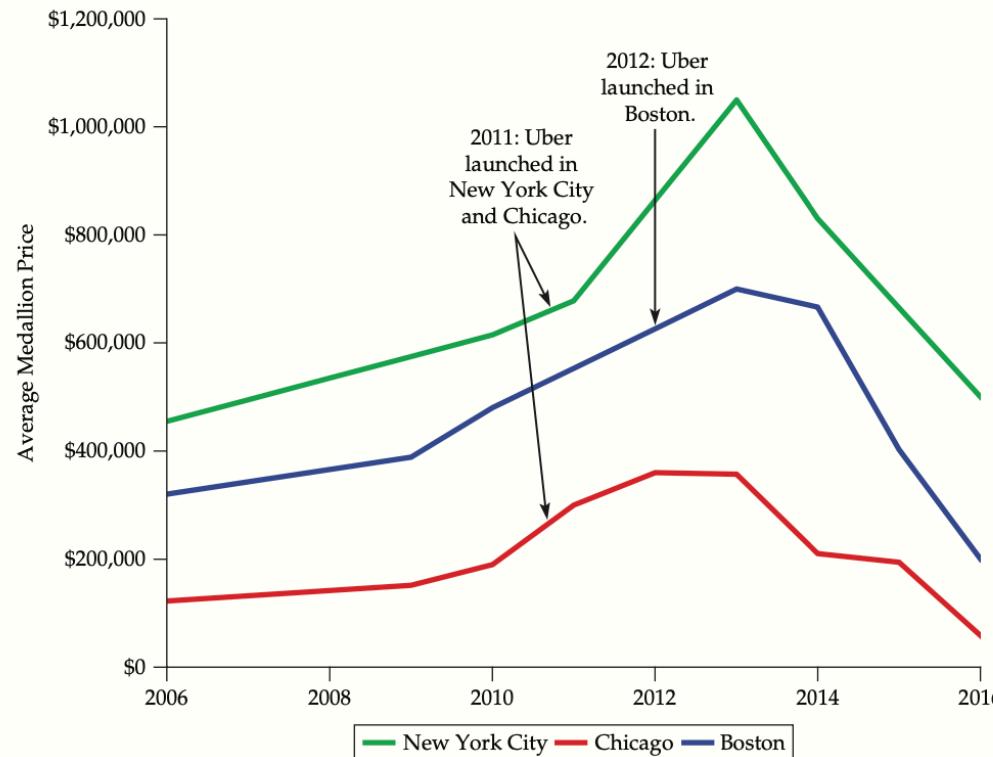


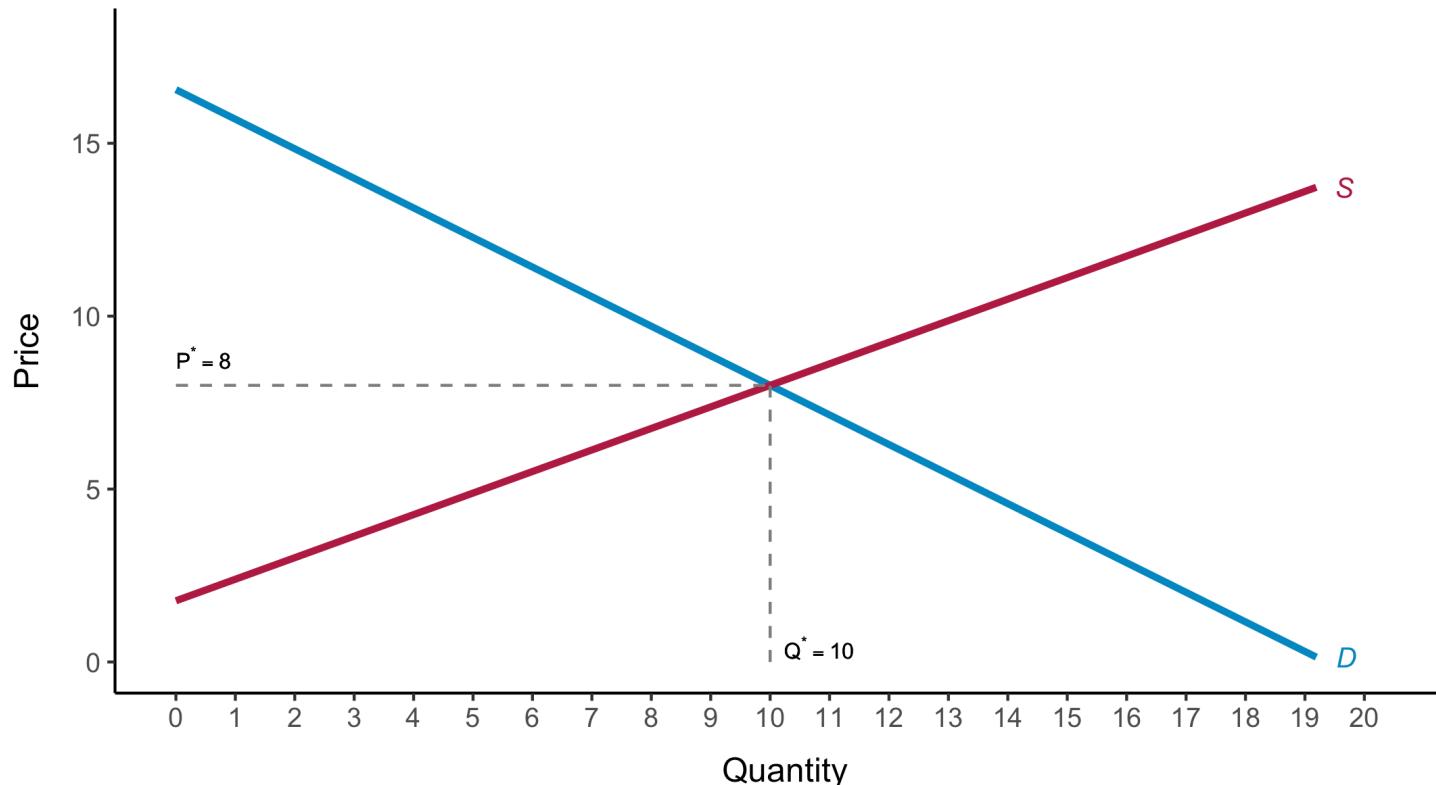
FIGURE 9.15

THE PRICES OF TAXI MEDALLIONS IN NEW YORK CITY, CHICAGO, AND BOSTON

Import Quotas and Tariffs

Import quotas

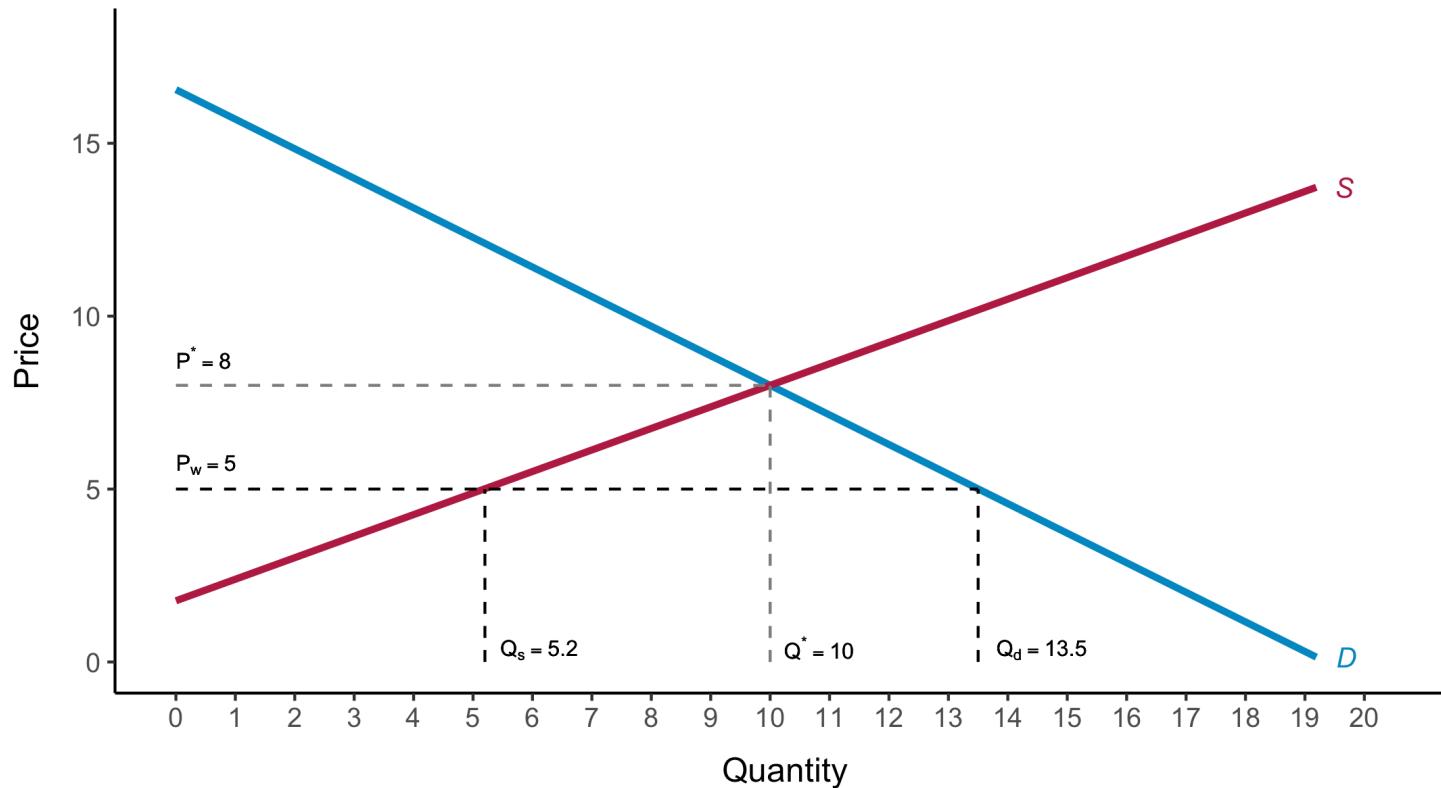
Many countries impose import quotas to raise domestic prices above world levels, boosting local industry profits.



$$Q_d = 16.6 - 0.855 \cdot P, \quad Q_s = 1.77 + 0.623 \cdot P$$

Import quotas

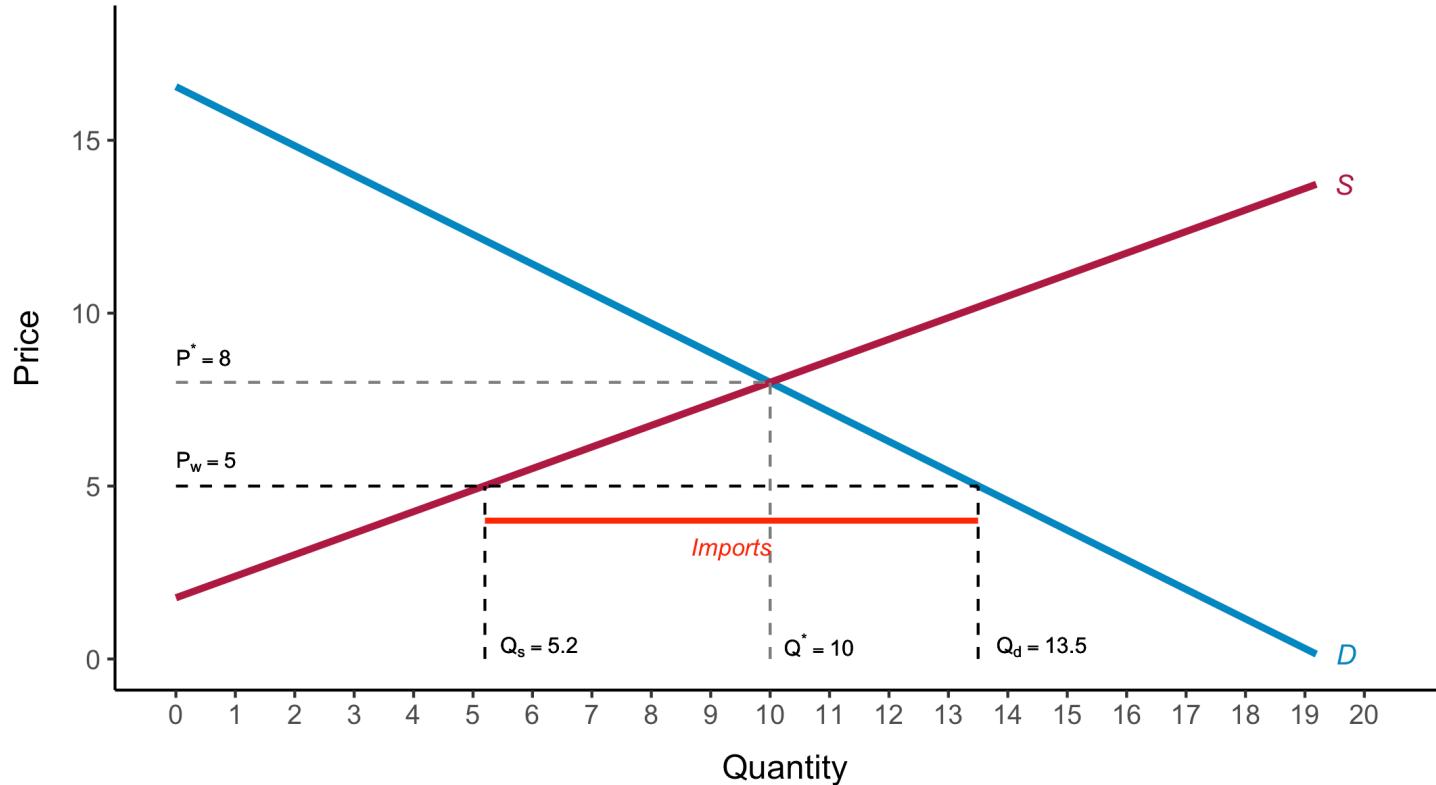
Without a quota or tariff, a country imports a good if its world price is lower than the domestic price without imports.



Global market with $P_w = 5$, at which $Q_s = 5.2$ and $Q_d = 12.3$.

Import quotas

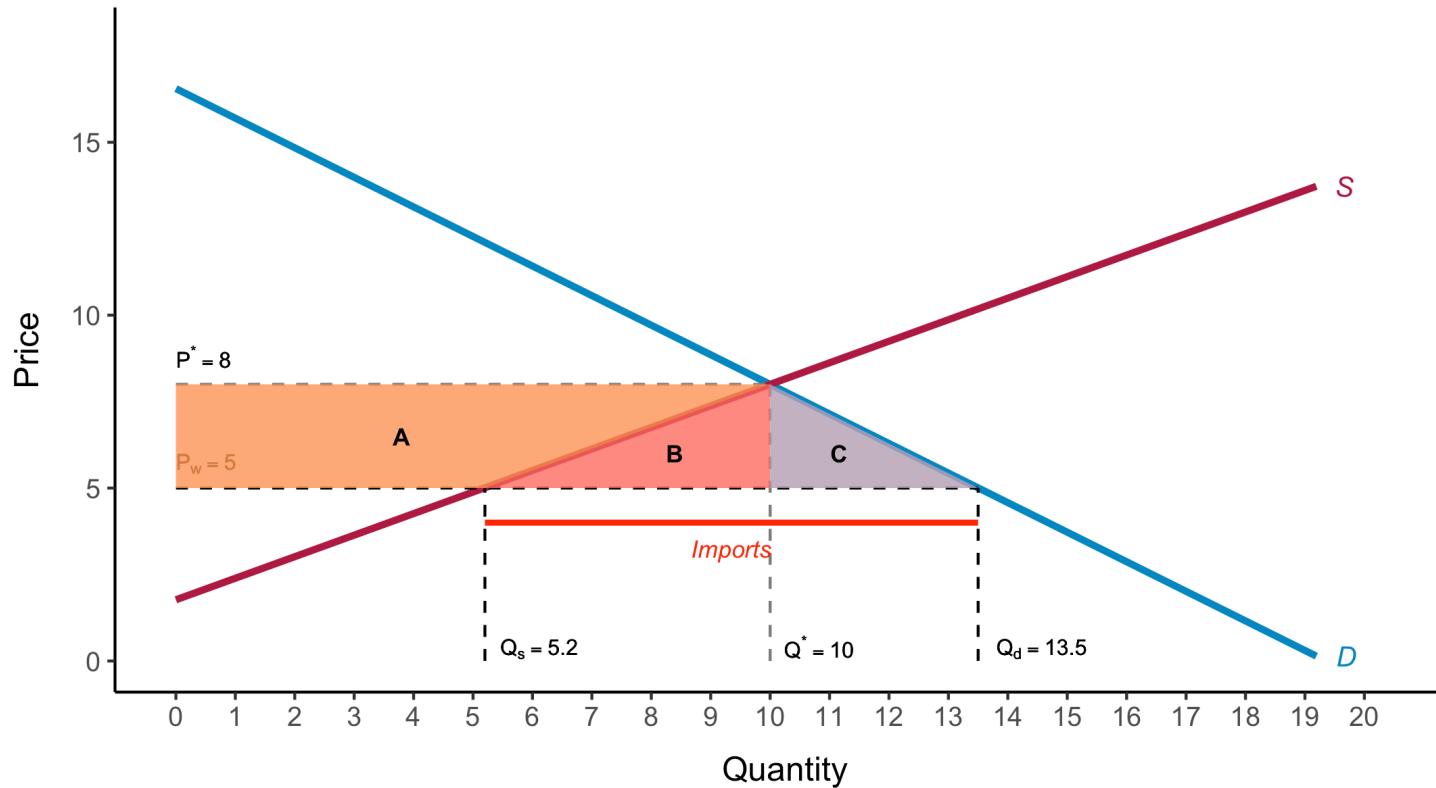
Without a quota or tariff, a country imports a good if its world price is lower than the domestic price without imports.



Global market with $P_w = 5$, at which $Q_s = 5.2$ and $Q_d = 13.5$. Thus, imports are $Q_d - Q_s = 8.3$.

Import quotas

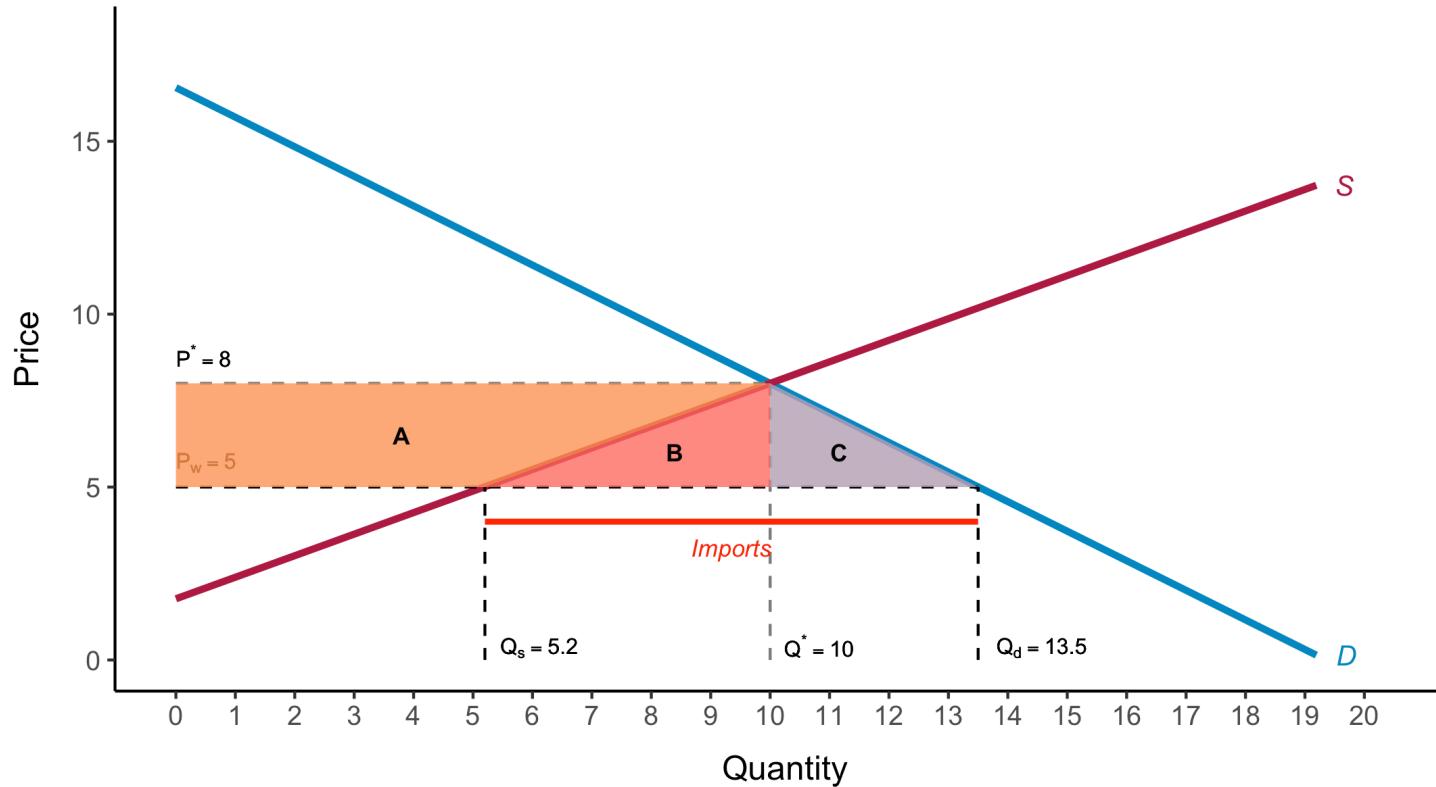
The government eliminates imports by imposing a quota of zero: forbidding any importation of the good.



Prices and quantities change to the local market equilibrium.

Import quotas

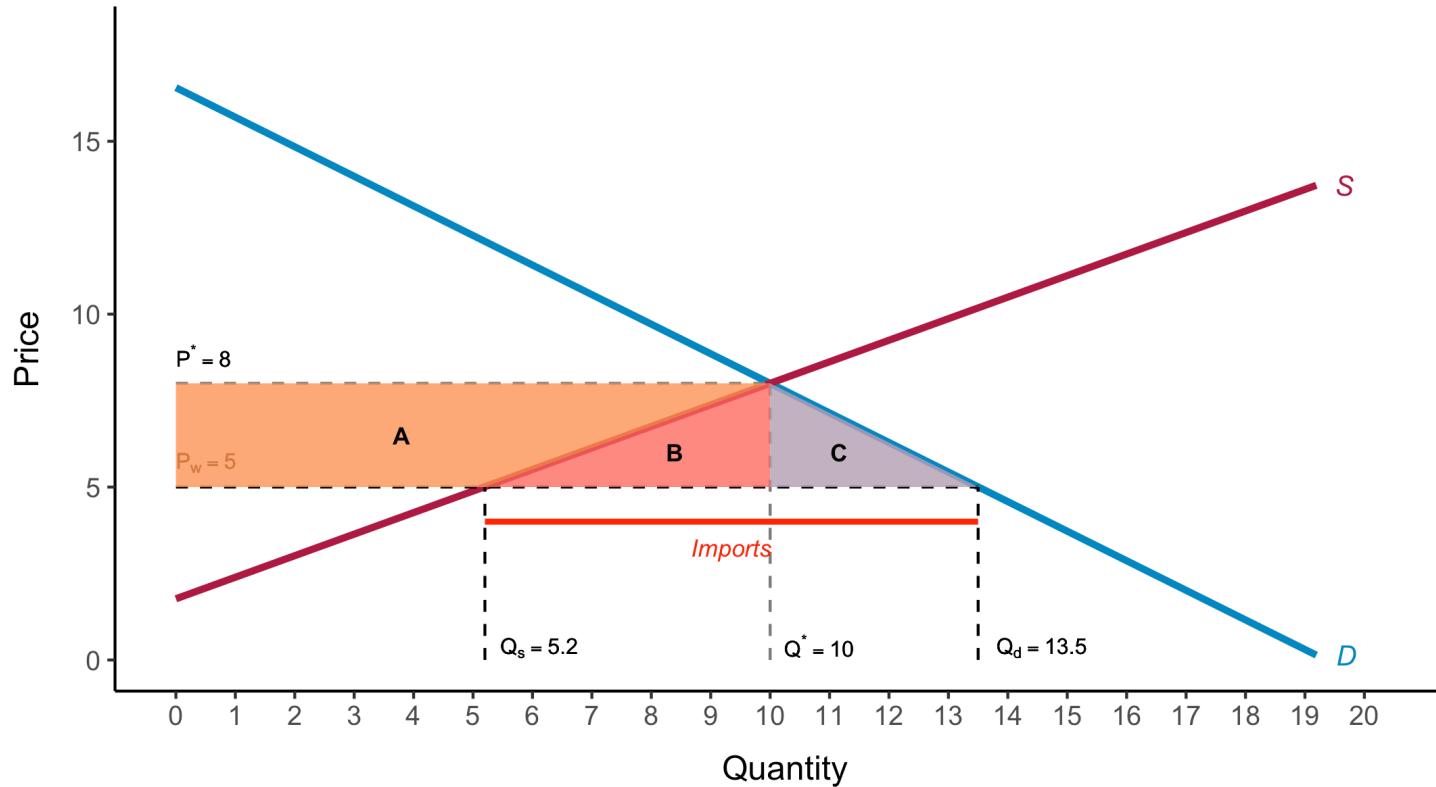
Change in Consumer Surplus: $\Delta CS = -A - B - C$



Prices and quantities change to the local market equilibrium.

Import quotas

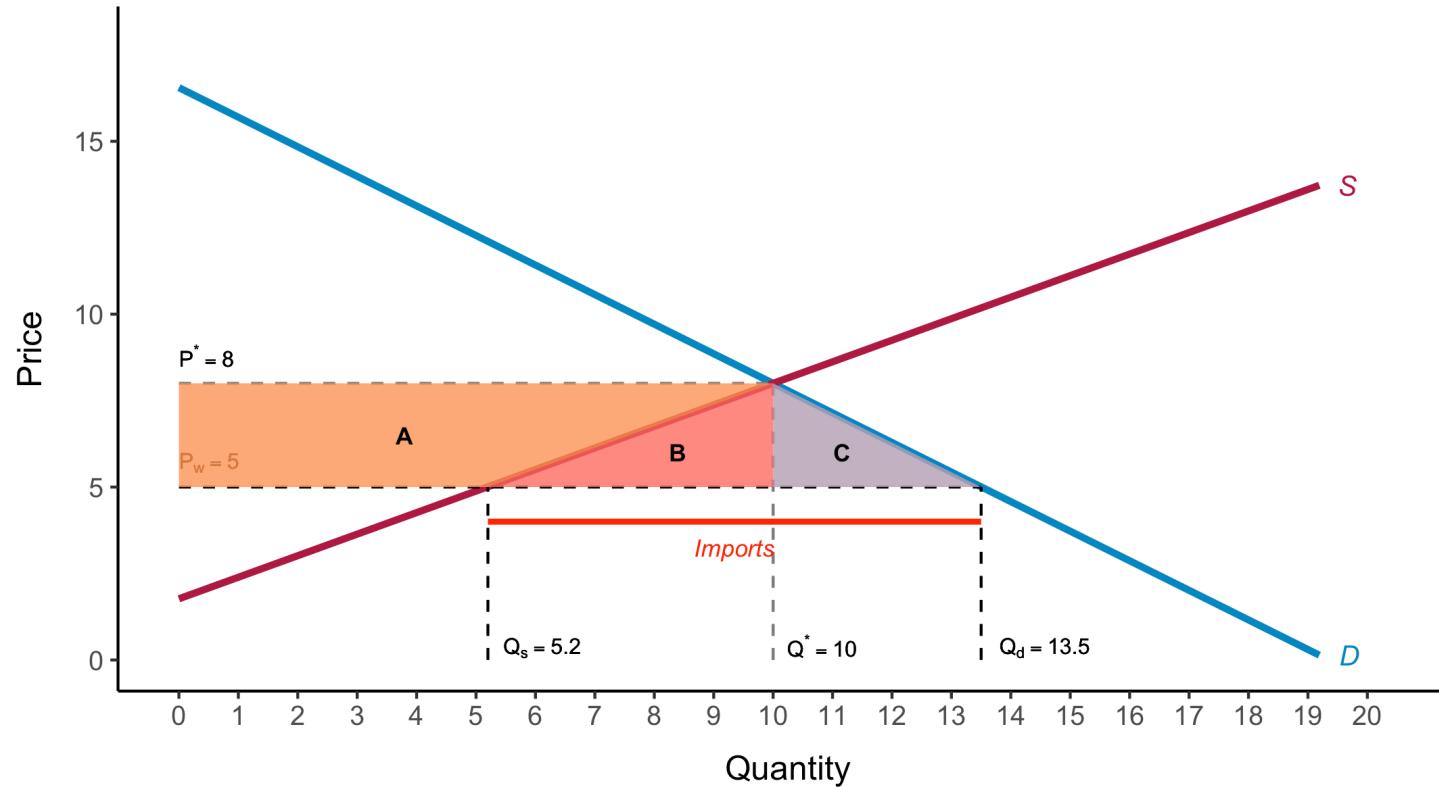
Change in Producer Surplus: $\Delta PS = A$



Prices and quantities change to the local market equilibrium.

Import quotas

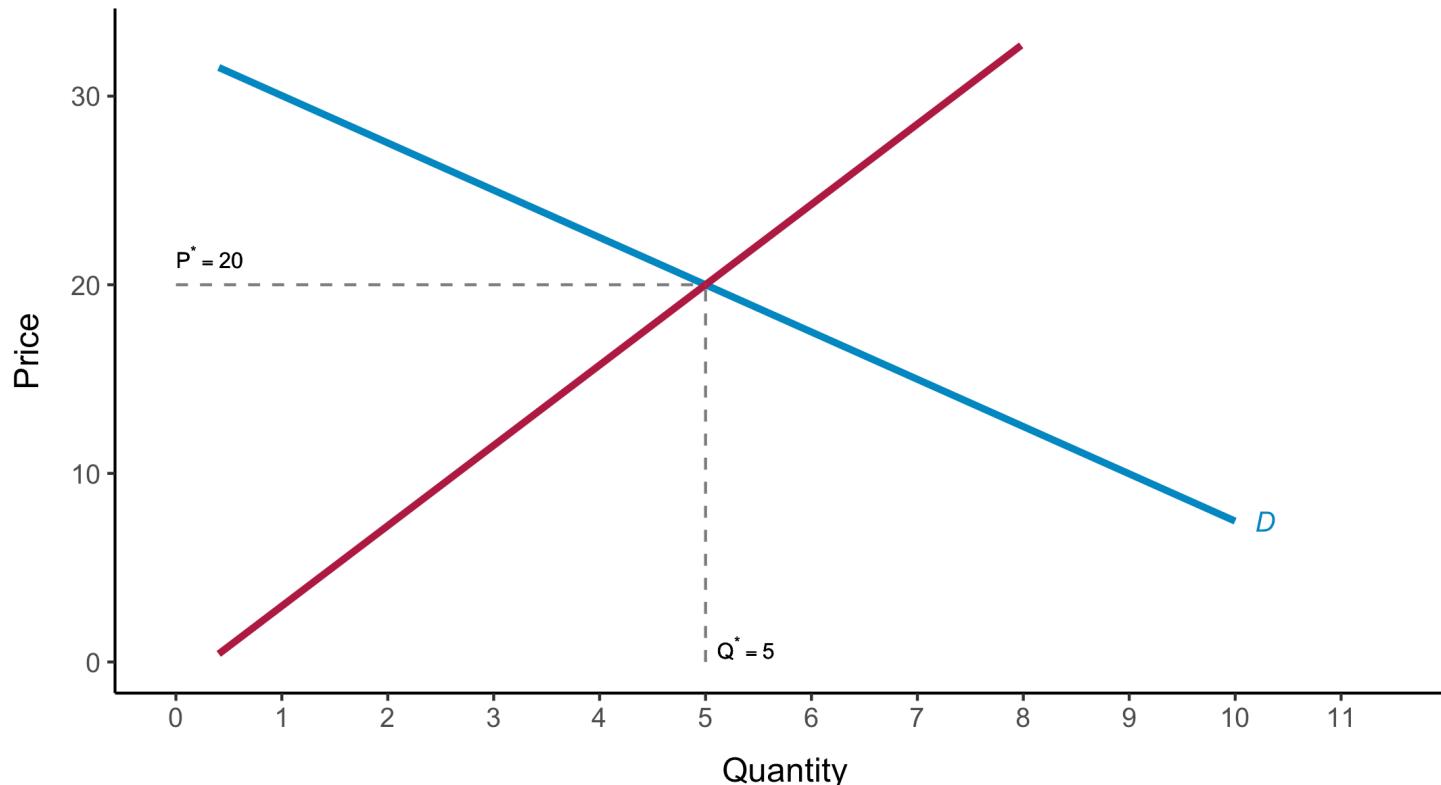
Change in Welfare results in a Deadweight Loss: $\Delta W = -B - C$



Prices and quantities change to the local market equilibrium.

Import tariff

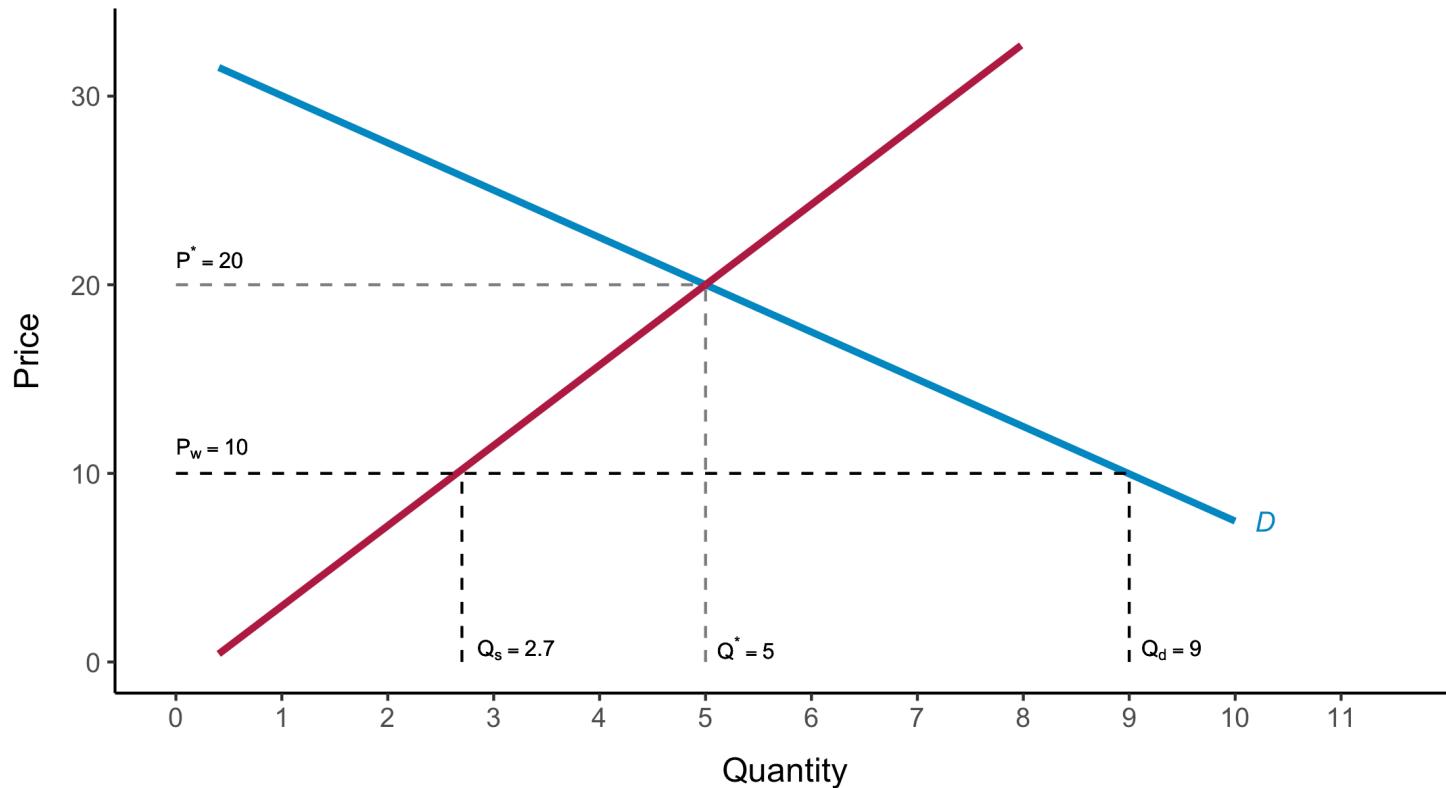
More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.



$$Q_d = 32.5 - 2.51 \cdot P, \quad Q_s = -1.30 + 4.26 \cdot P$$

Import tariff

More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.



Global market with $P_w = 10$, at which $Q_s = 2.7$ and $Q_d = 9$. Thus, imports are $Q_d - Q_s = 6.3$.

Import tariff

More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.

Augmentation des taxes aux frontières : Donald Trump met la douane dans l'engrenage

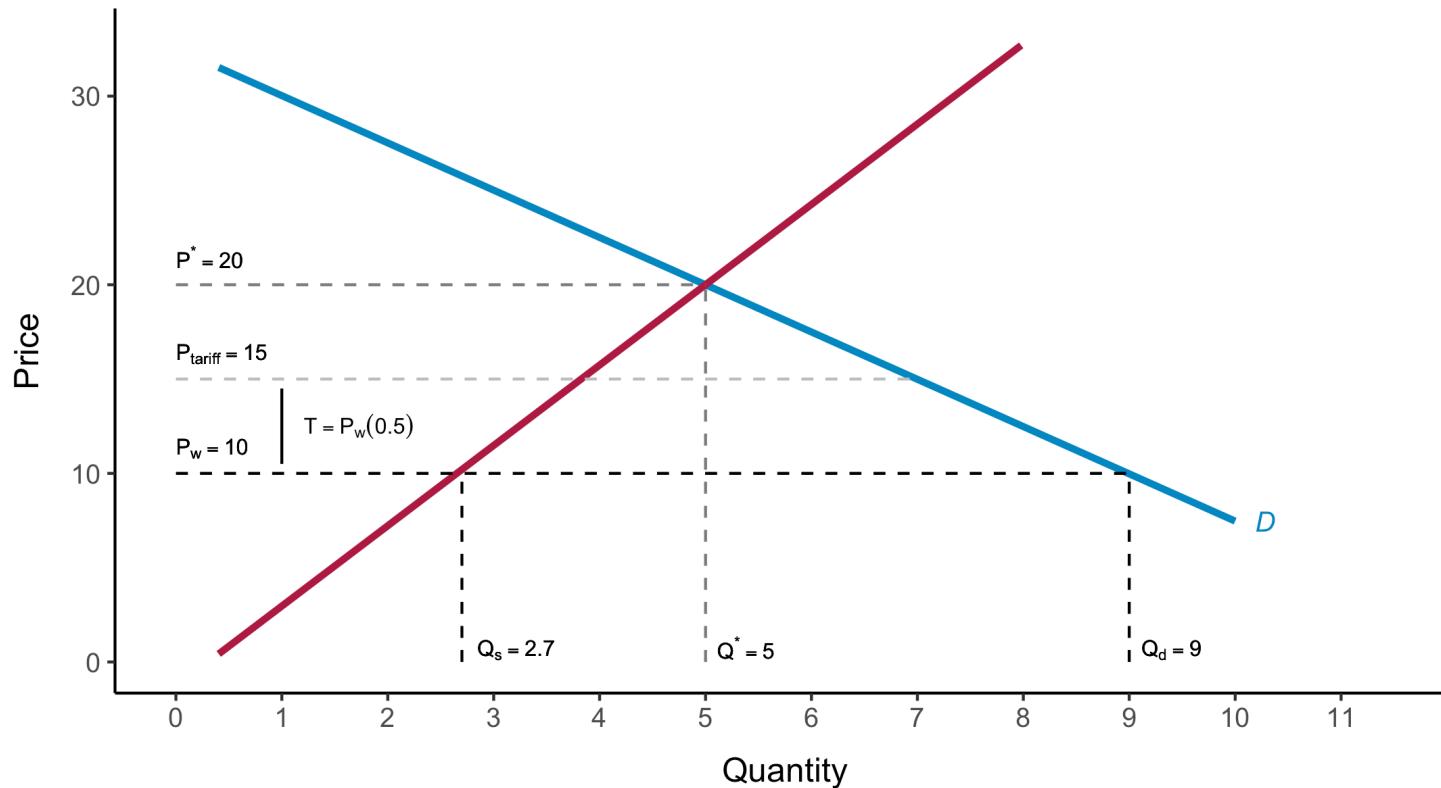
Article réservé aux abonnés

Le président américain a annoncé augmenter les taxes sur les produits venant du Canada, du Mexique et de la Chine. Une nouvelle guerre commerciale absurde qui risque de plonger les Etats-Unis et ses voisins dans le marasme économique.



Import tariff

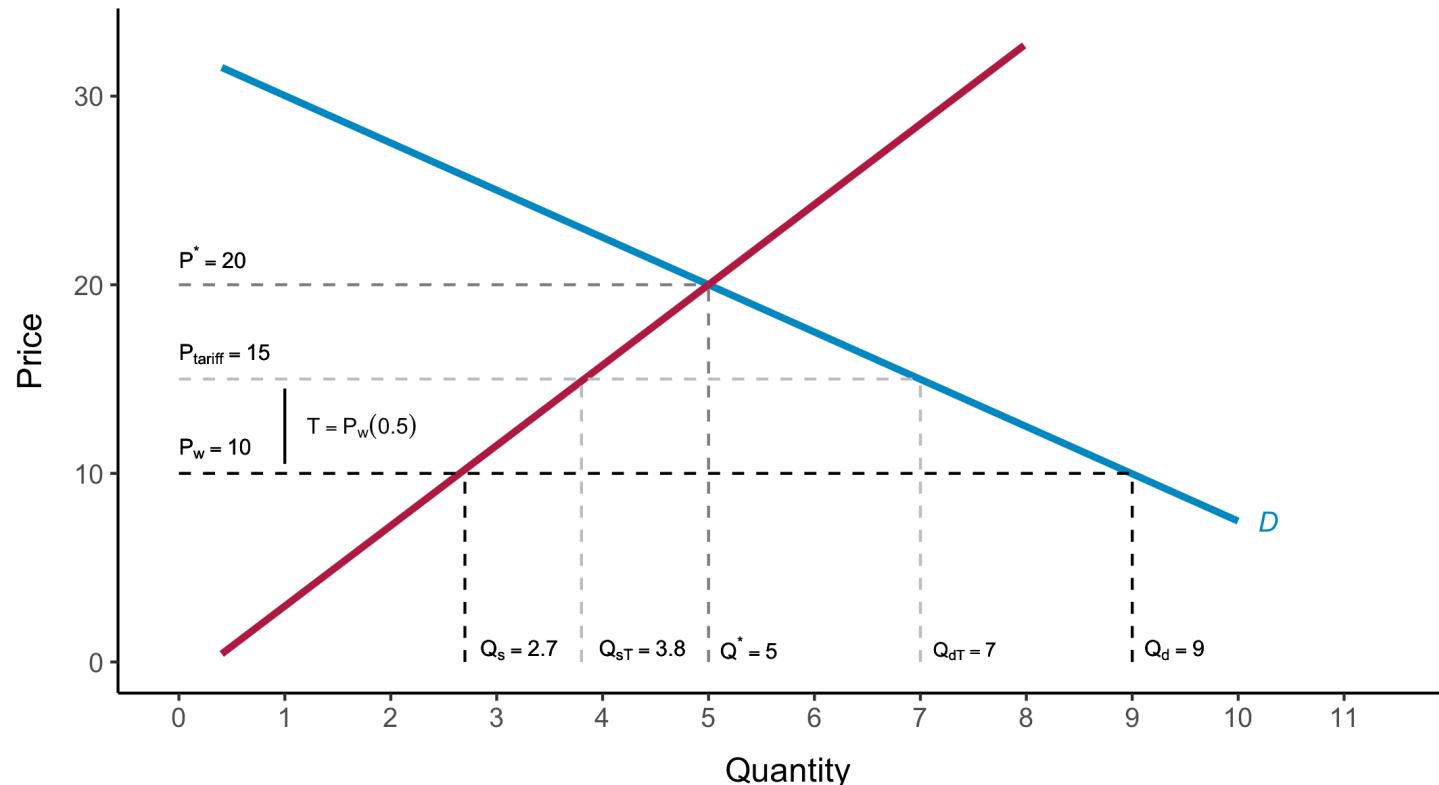
More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.



Suppose a 50% tariff on imports. Thus, local price increases to $P_{tariff} = 15$.

Import tariff

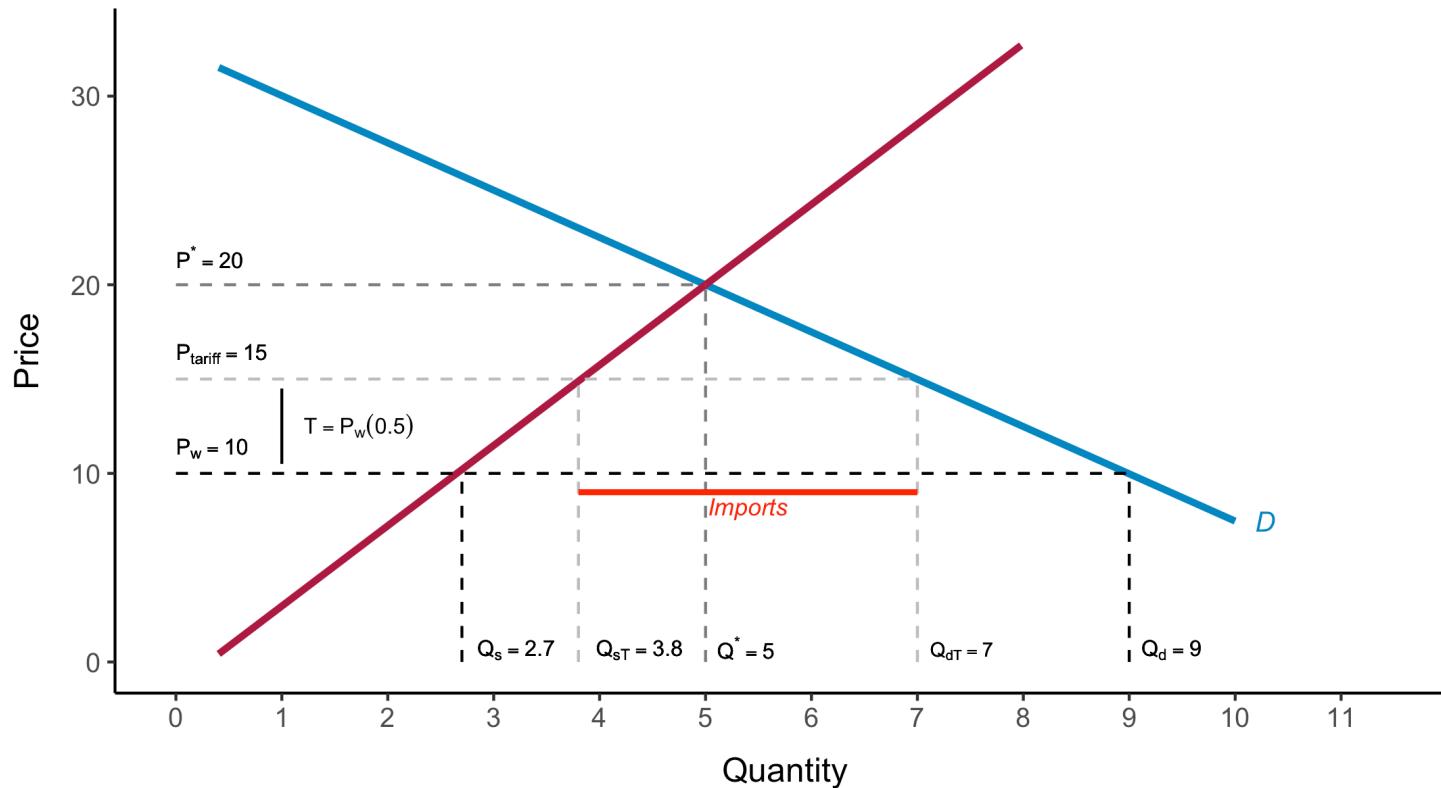
More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.



At $P_{tariff} = 15$, $Q_{sT} = 3.8$ and $Q_{dT} = 7$.

Import tariff

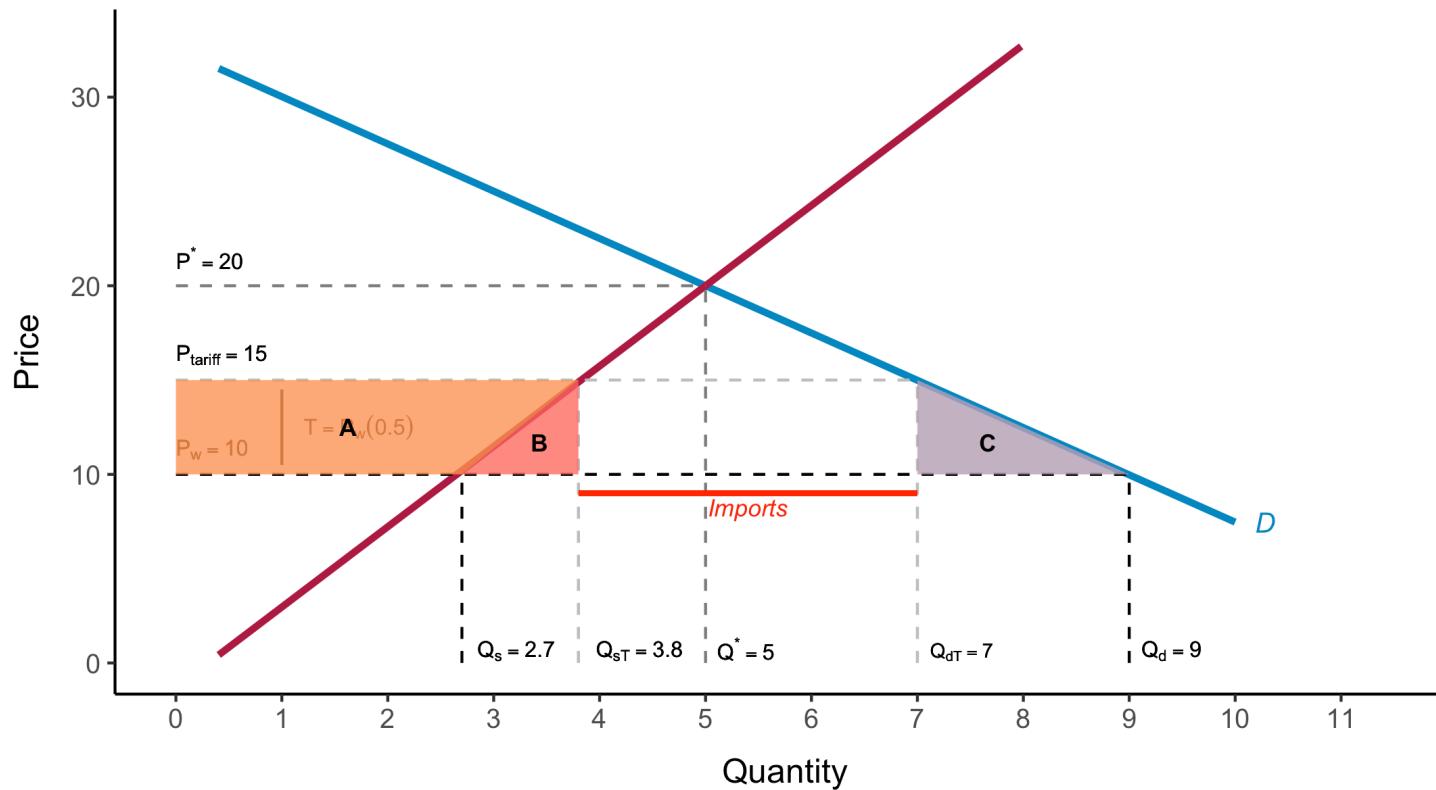
More often, government policy is designed to reduce but not eliminate imports. Impose of tariffs: taxes on imported goods.



At $P_{tariff} = 15$, $Q_{sT} = 3.8$ and $Q_{dT} = 7$. Thus imports with tariffs are reduced to $Q_{dT} - Q_{sT} = 3.2$.

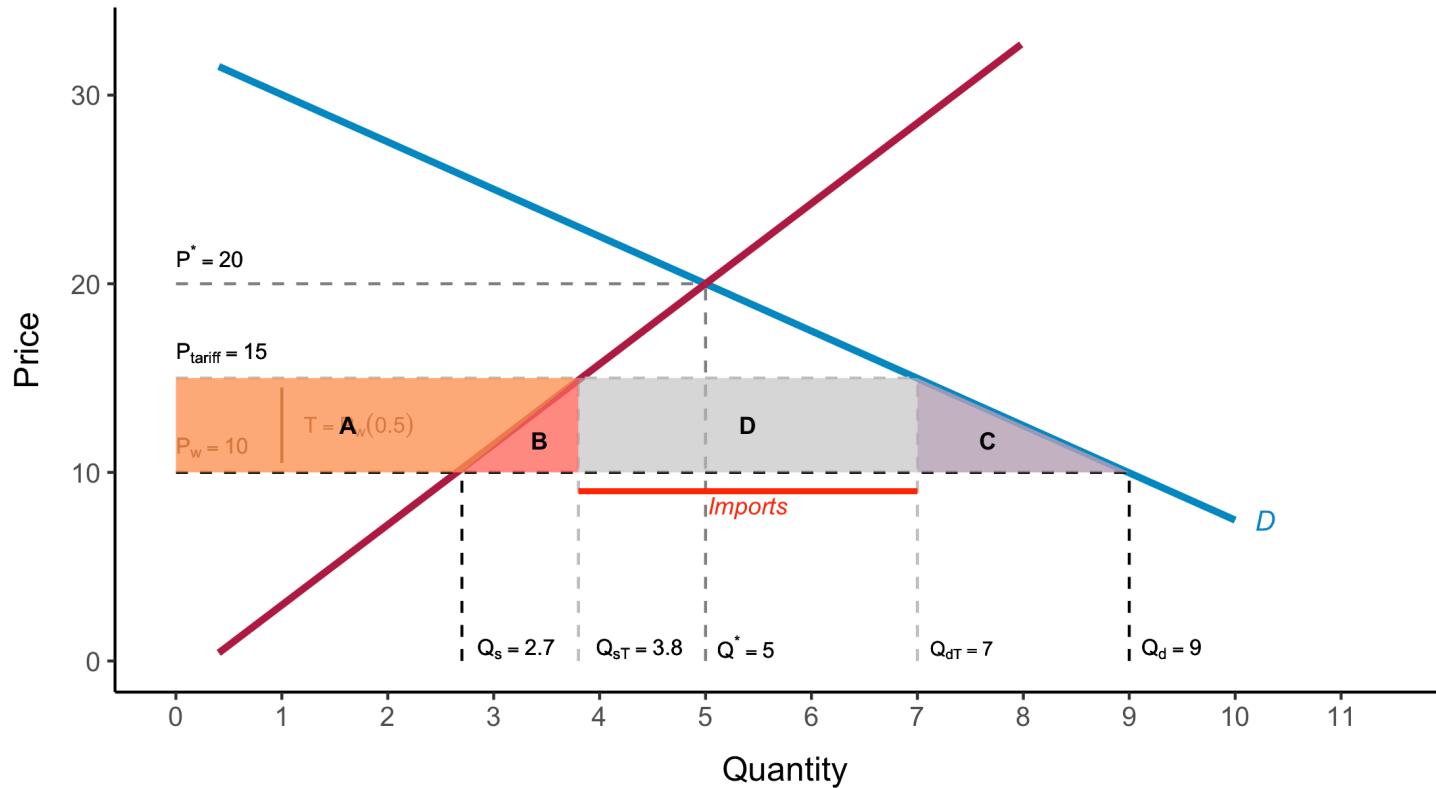
Import tariff

Change in Consumer Surplus: $\Delta CS = -A - B - C$



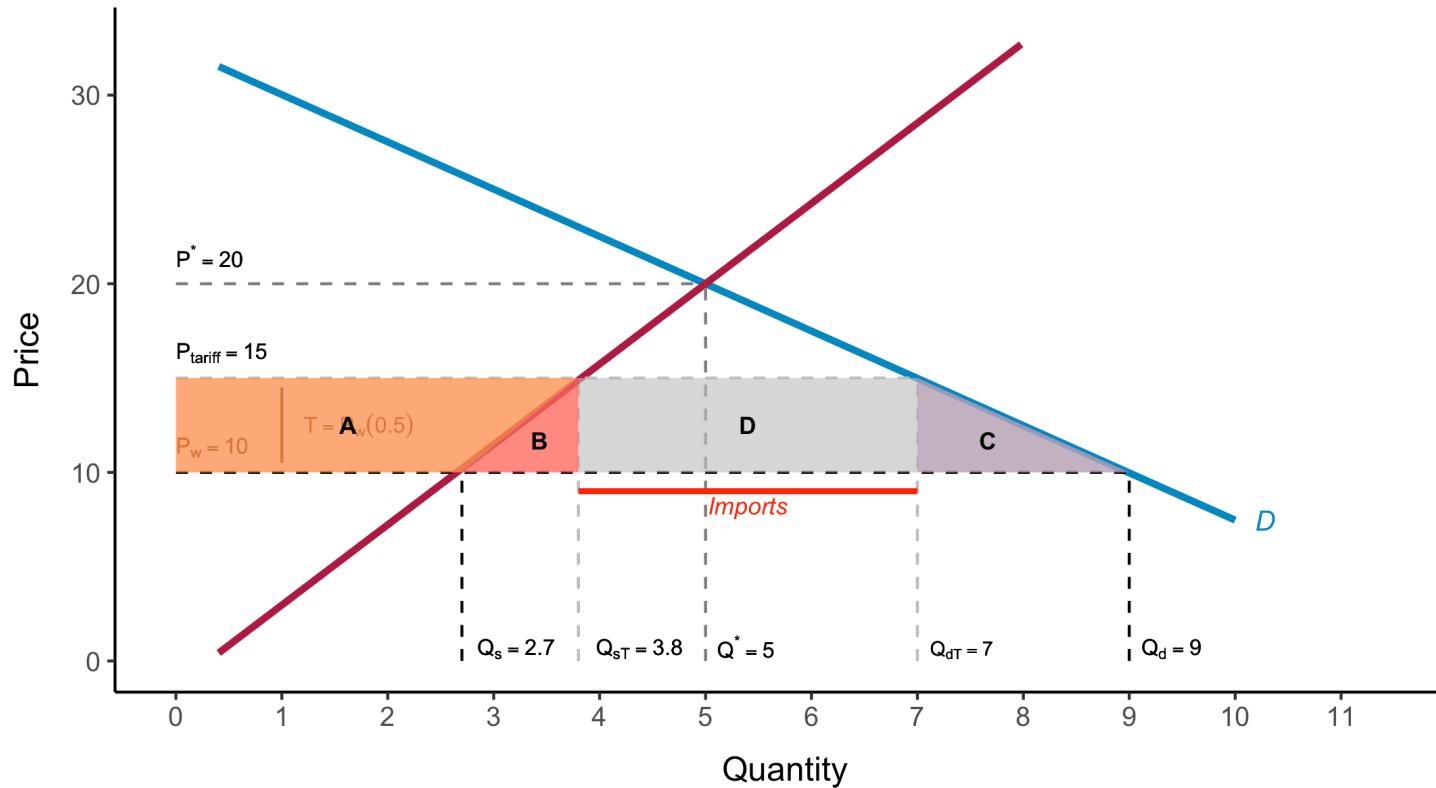
Import tariff

Change in Consumer Surplus: $\Delta CS = -A - B - C - D$



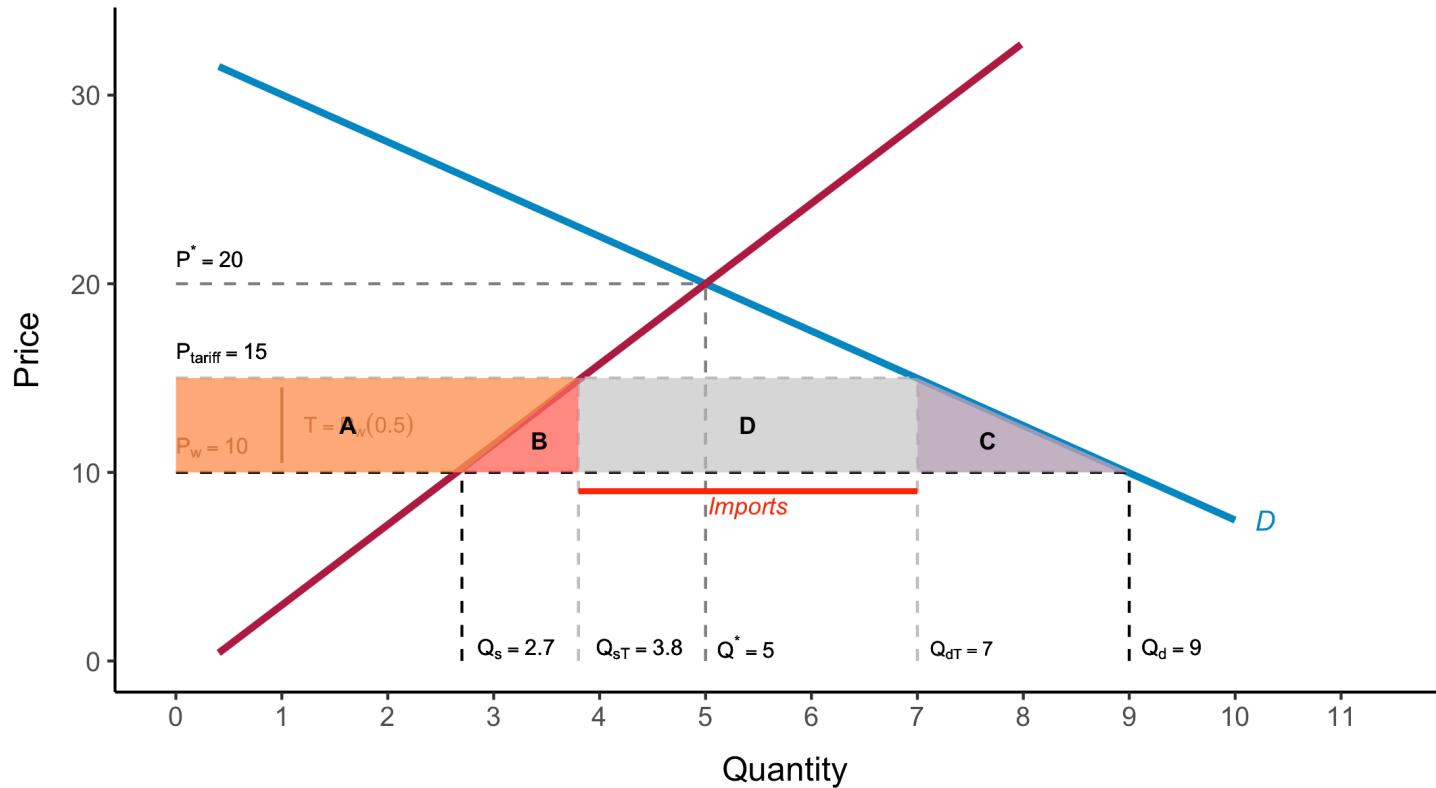
Import tariff

Change in Producer Surplus: $\Delta PS = A$



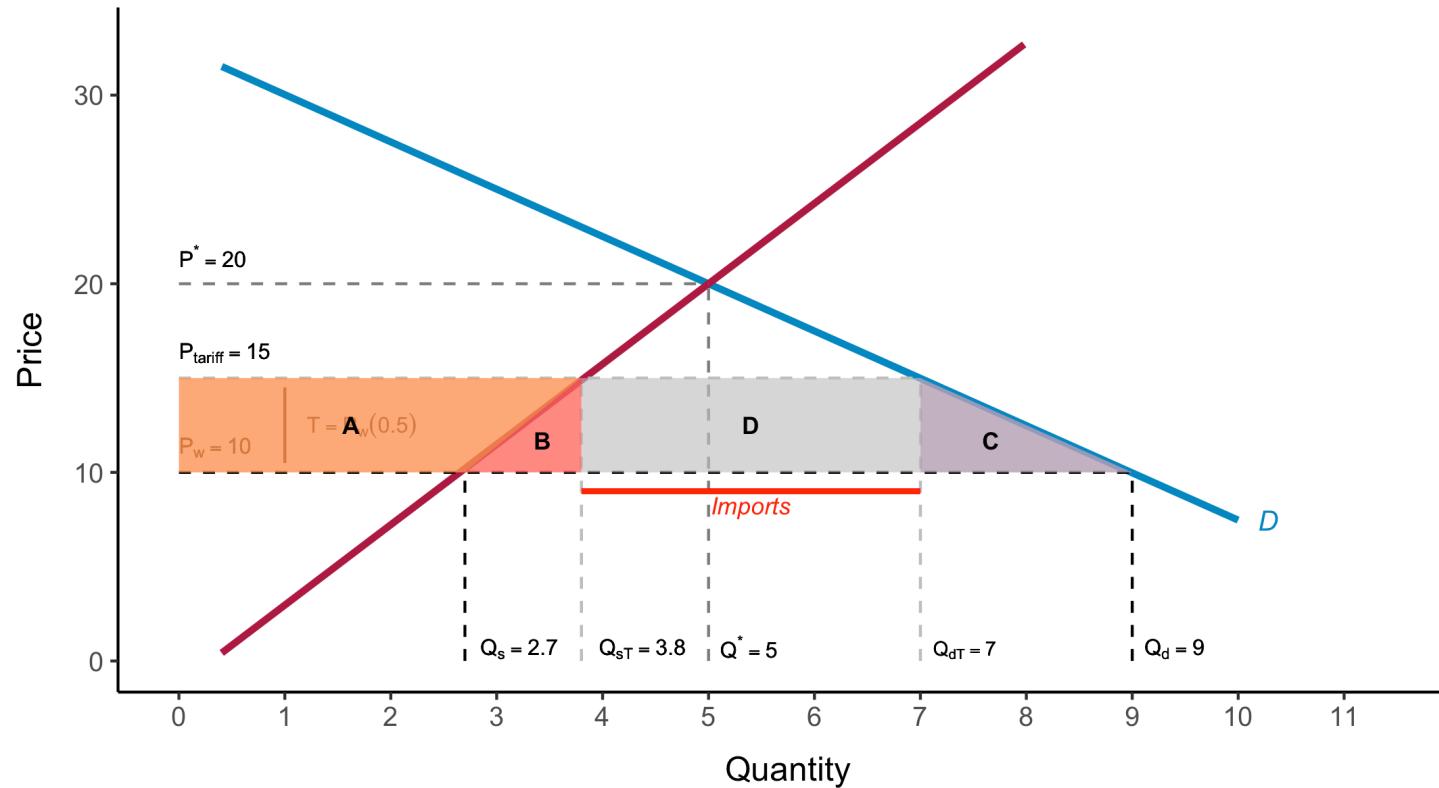
Import tariff

Government revenue: D



Import tariff

Change in Welfare results in a Deadweight Loss: $\Delta W = -B - C$



The Impact of a Tax or Subsidy

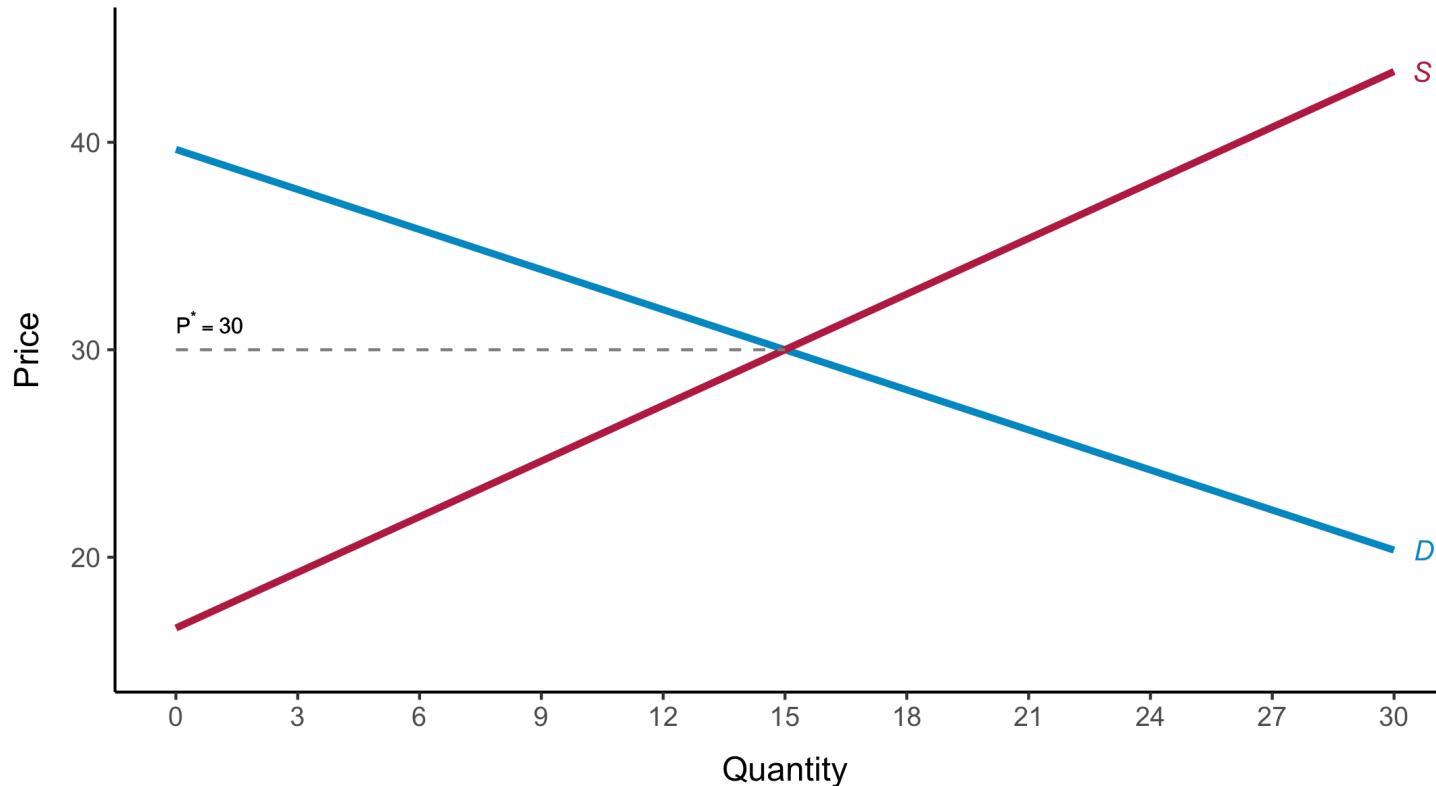
The Impact of a Tax

- What happens to the price of a good if the government imposed a \$1 tax on every widget sold?
- Who would pay the tax? Consumers? Producers?

It depends!

The Impact of a Tax

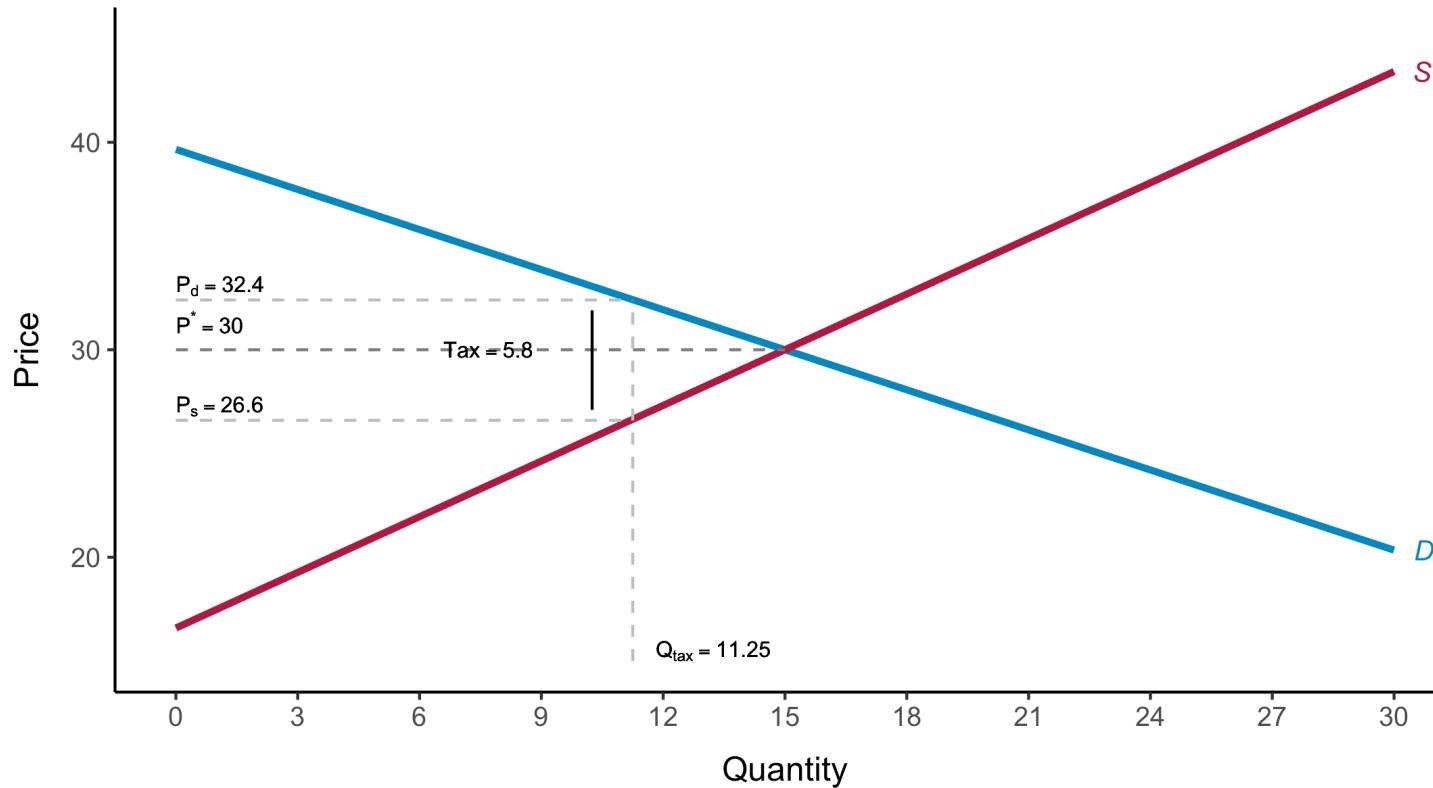
How a tax on a product affects consumers, producers, price, and quantity.



$$Q_d = 39.7 - 0.644 \cdot P, \quad Q_s = 16.6 + 0.894 \cdot P$$

The Impact of a Tax

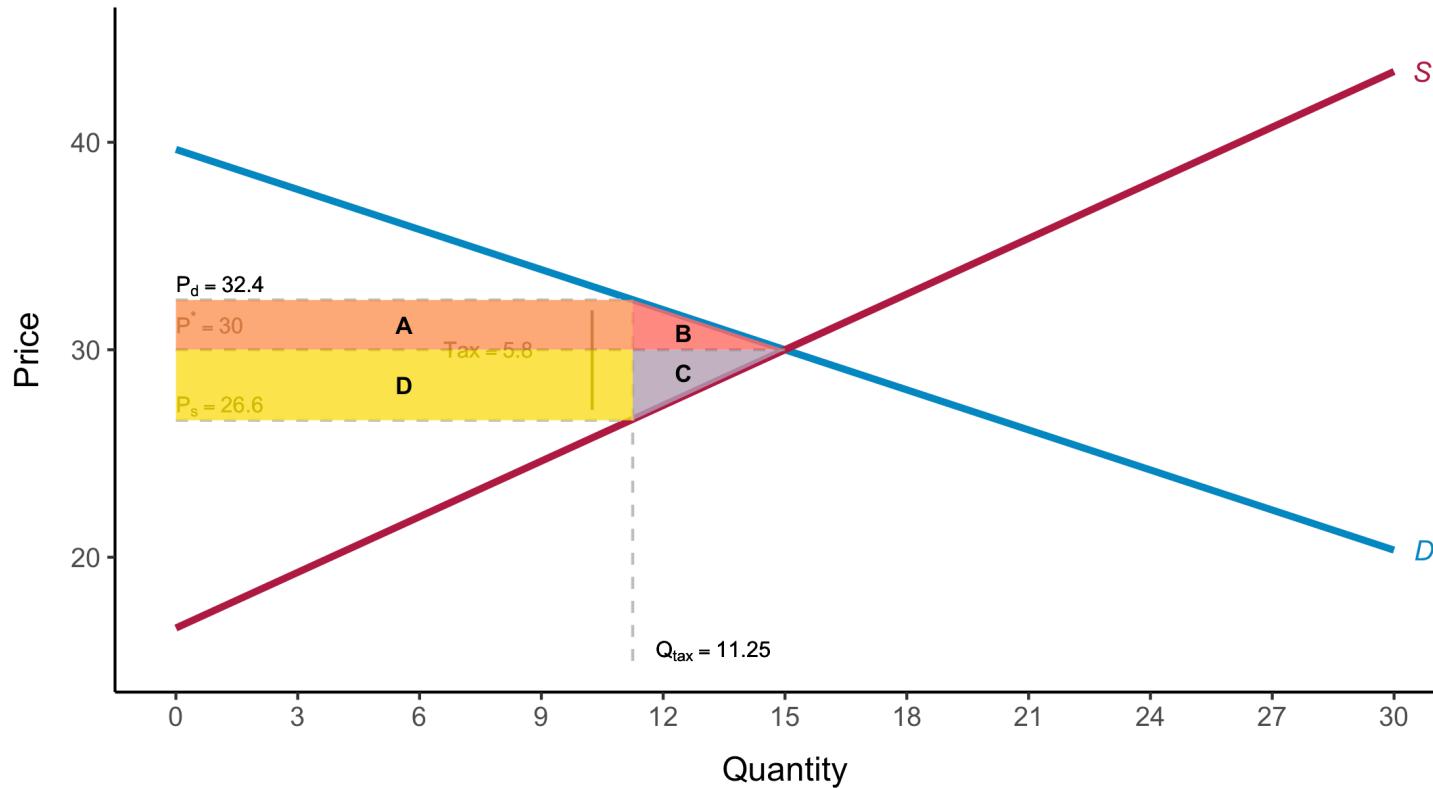
How a tax on a product affects consumers, producers, price, and quantity.



Suppose a 13.7 tax per unit (lump-sum). At such tax, $P_d = 30.6$, $P_s = 16.9$, and $Q_{tax} = 20$.

The Impact of a Tax

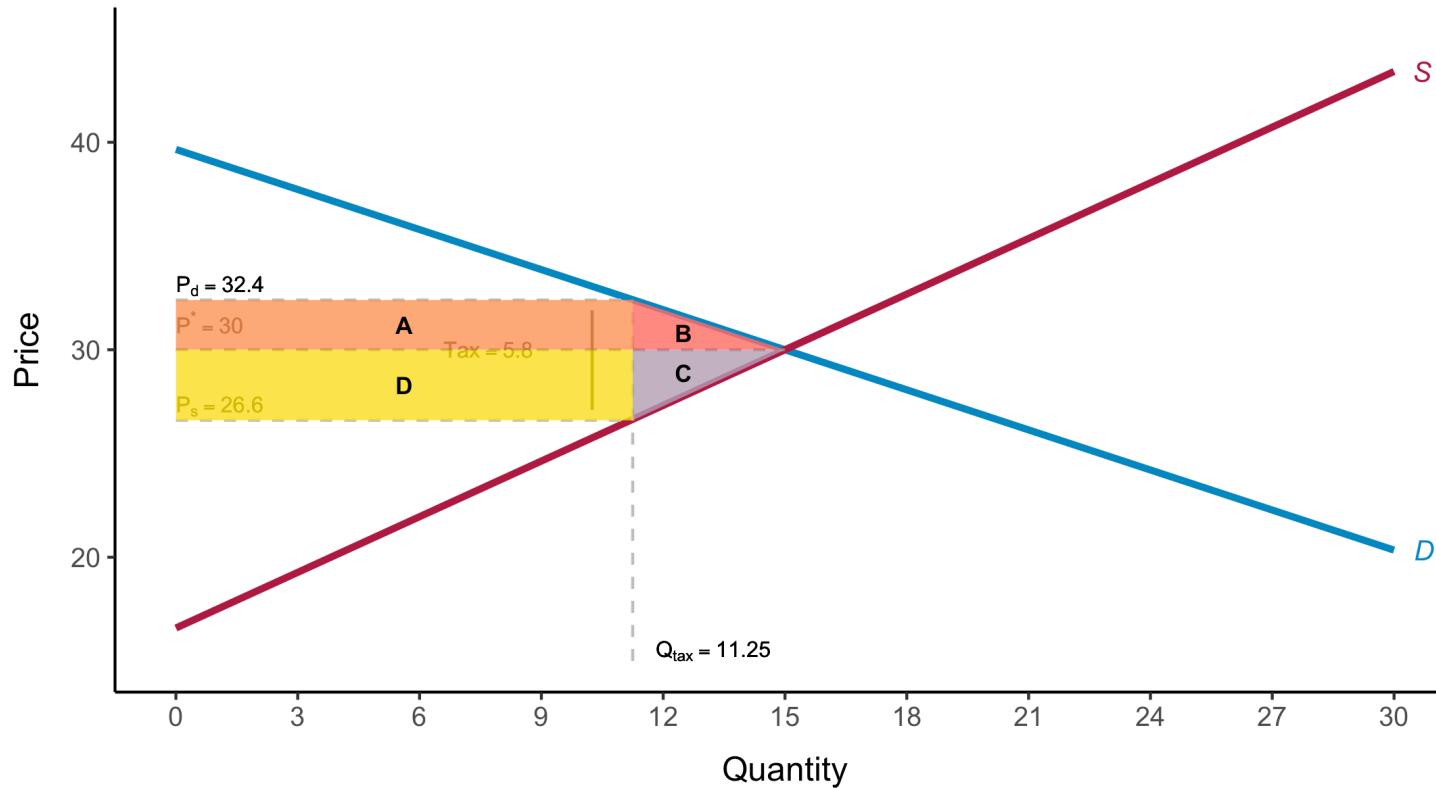
How a tax on a product affects consumers, producers, price, and quantity.



$$\Delta CS = -A - B$$

The Impact of a Tax

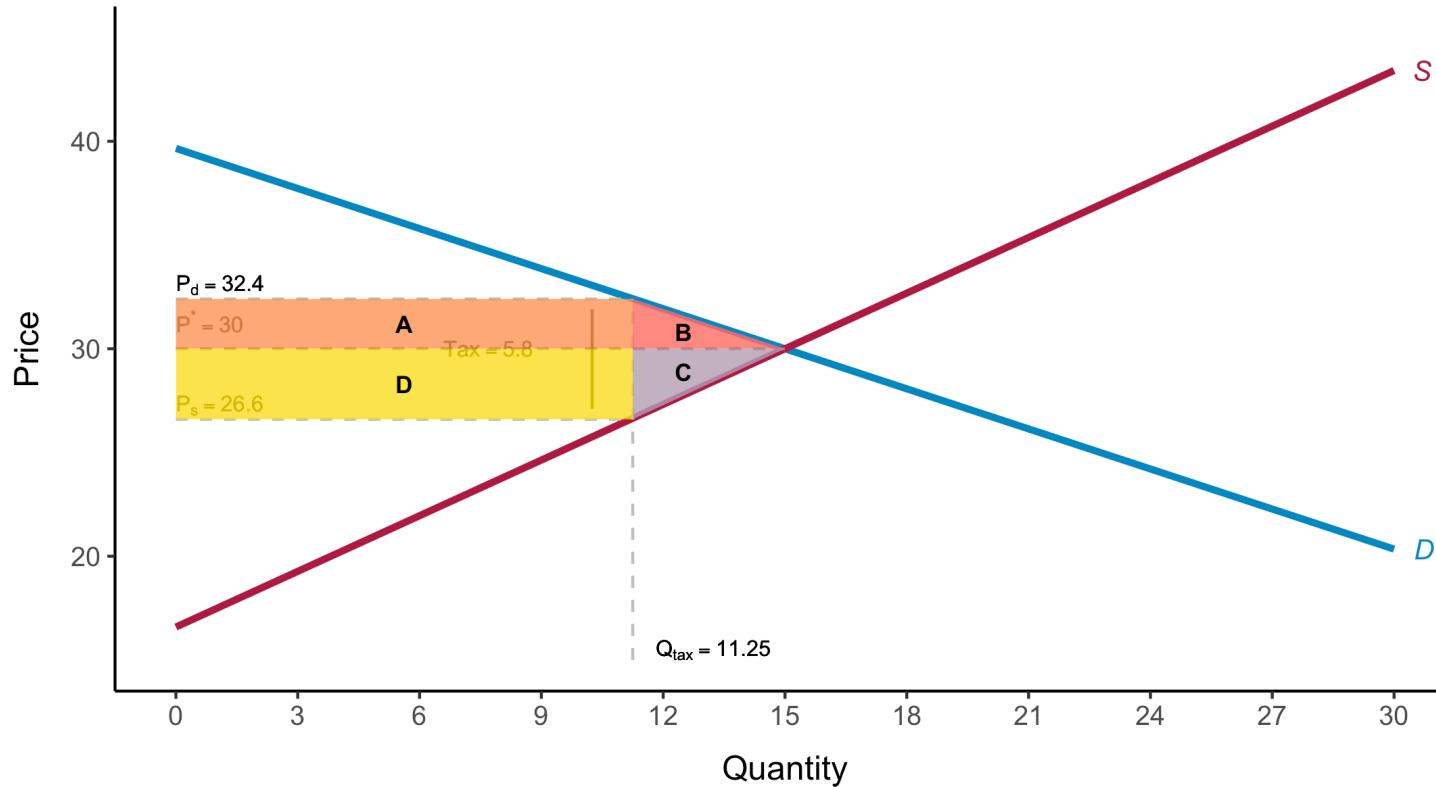
How a tax on a product affects consumers, producers, price, and quantity.



$$\Delta PS = -D - C$$

The Impact of a Tax

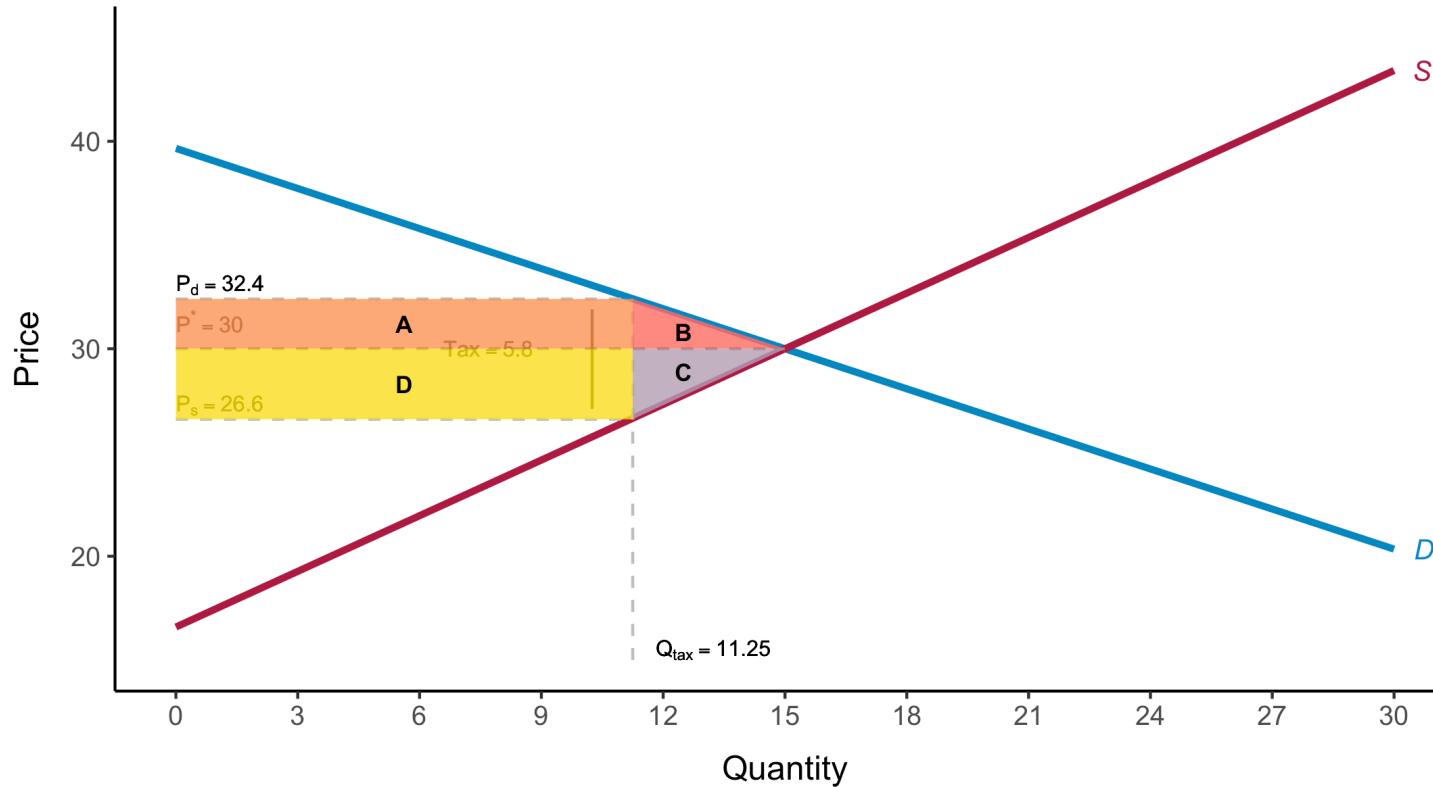
How a tax on a product affects consumers, producers, price, and quantity.



$$\text{Govt. Earnings} = A + D$$

The Impact of a Tax

How a tax on a product affects consumers, producers, price, and quantity.



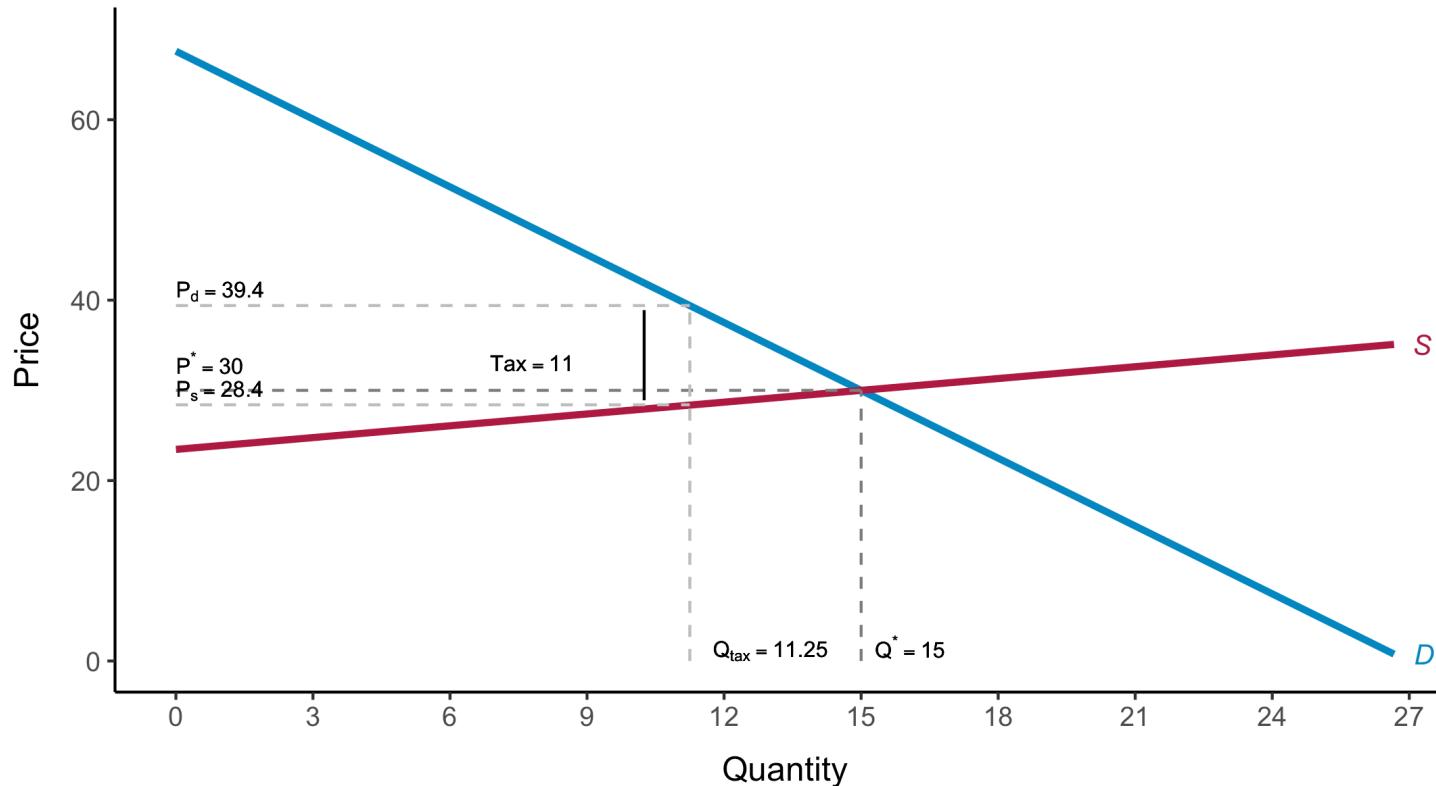
$$\Delta W = -B - C$$

The Impact of a Tax

Guess what? The impact of the tax depends on elasticities.

The Impact of a Tax

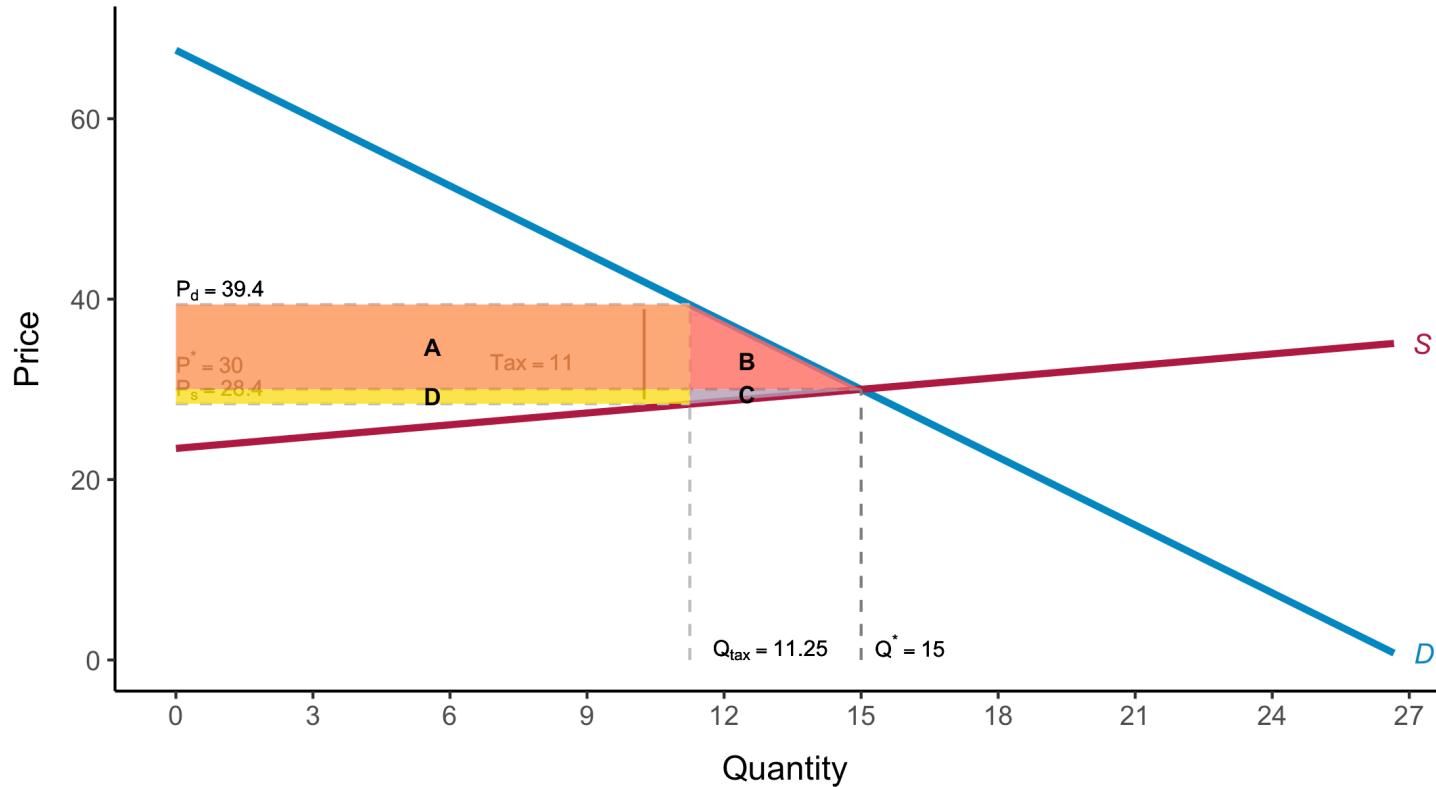
Suppose demand is relatively more inelastic.



$$Q_d = 67.6 - 2.51 \cdot P, \quad Q_s = 23.5 + 0.436 \cdot P$$

The Impact of a Tax

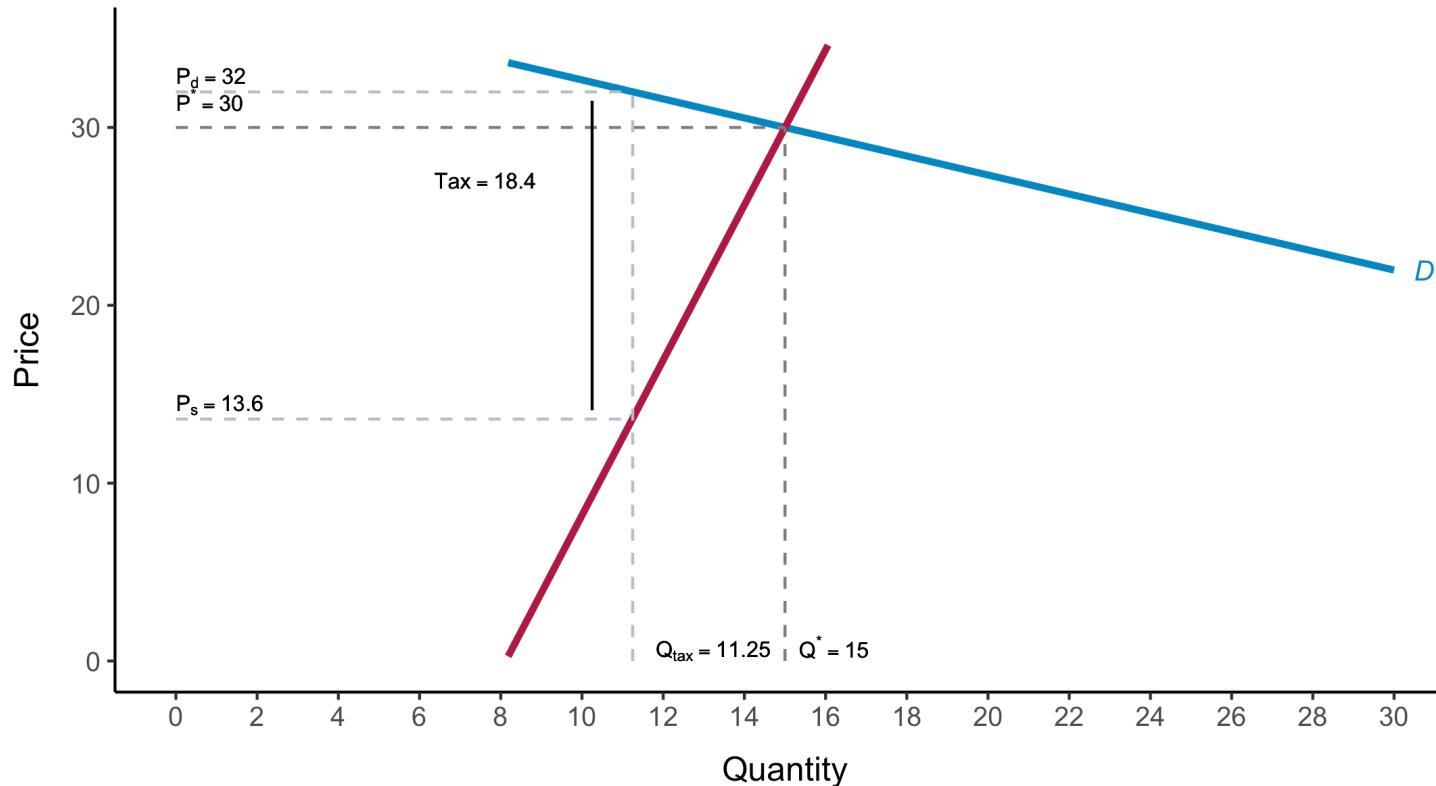
Suppose demand is relatively more inelastic. **The burden of the tax falls mostly on buyers.**



E.g. Cigarettes

The Impact of a Tax

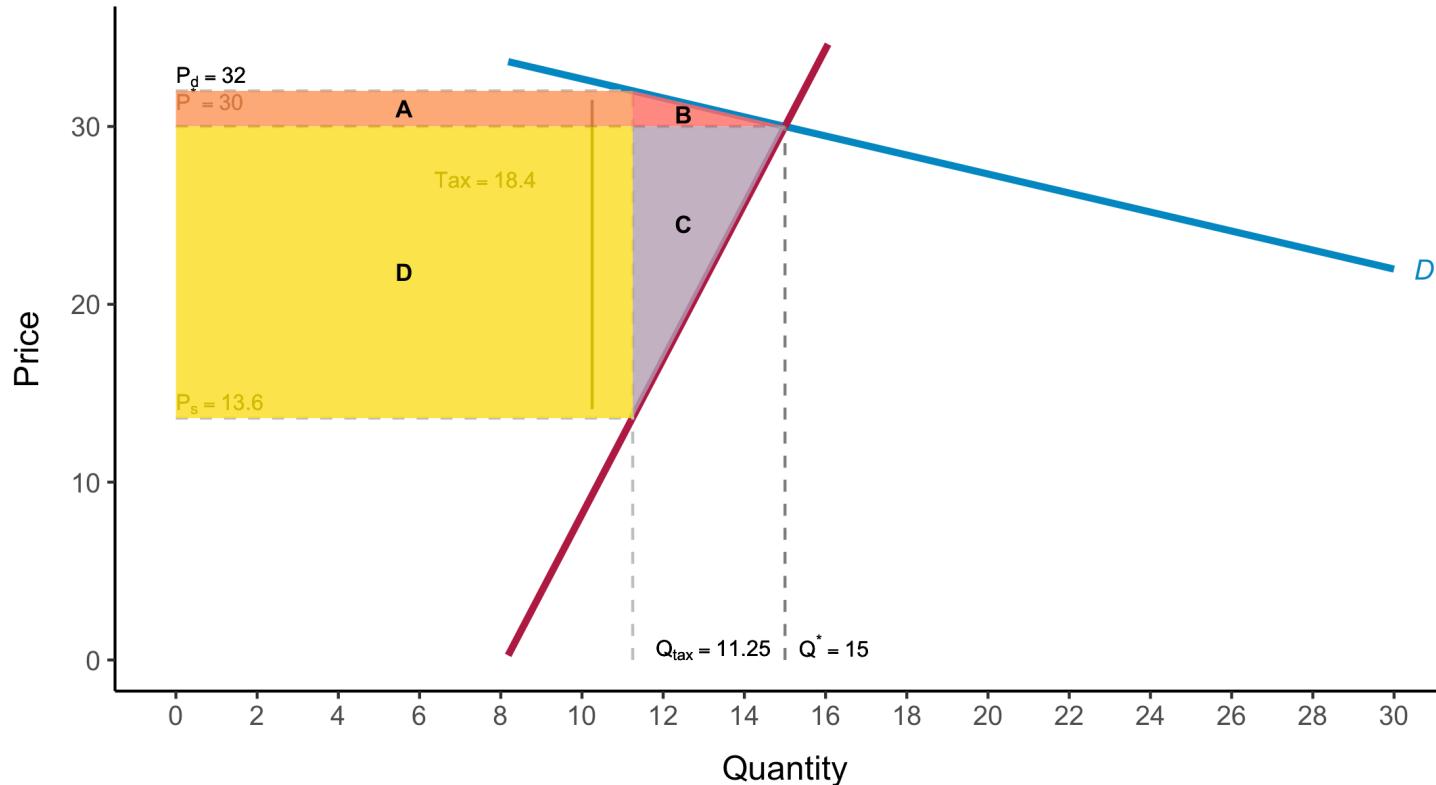
Suppose supply is relatively more inelastic.



$$Q_d = 38.0 - 0.535 \cdot P, \quad Q_s = -35.4 + 4.36 \cdot P$$

The Impact of a Tax

Suppose supply is relatively more inelastic. **The burden of the tax falls mostly on sellers.**



E.g. Housing

The Impact of a Tax

Tax incidence: What fraction of the tax is “passed through” to consumers in the form of higher prices?

$$Pass-through_{consumers} = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D}$$

$$Pass-through_{suppliers} = \frac{-\varepsilon_D}{\varepsilon_S - \varepsilon_D}$$

If $\varepsilon_D \rightarrow 0$

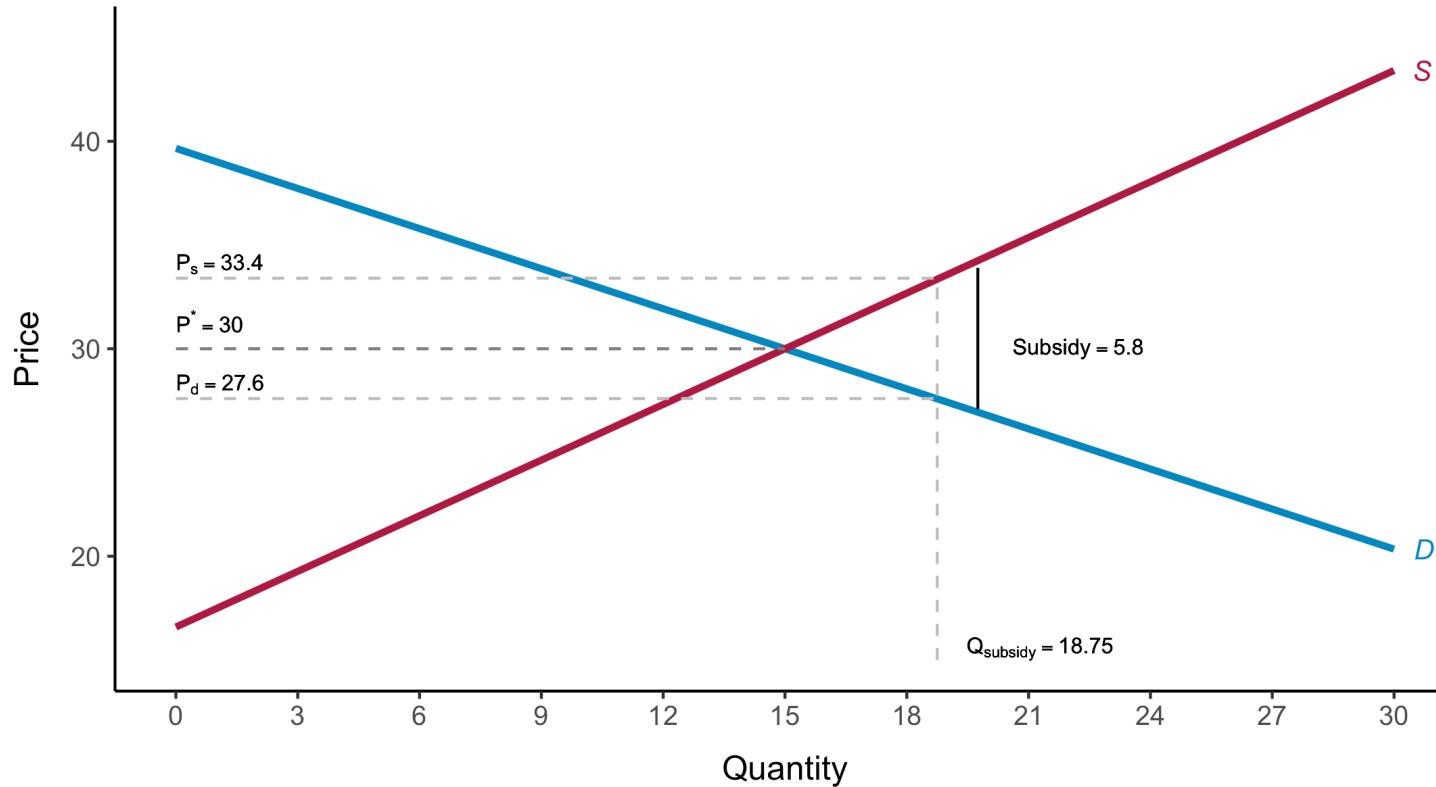
$$\Rightarrow Pass-through_{consumers} = 1$$

If $\varepsilon_S \rightarrow 0$

$$\Rightarrow Pass-through_{suppliers} = 1$$

The Impact of a Subsidy

Pretty much the same of a tax. In fact, a **negative tax**.



Summary

Summary

- **Supply and demand models** help analyze government policies like price controls, subsidies, tariffs, and quotas.
- **Consumer and producer surplus** are used to measure gains and losses from policies, which can be significant in cases like price controls and airline regulation.
- **Taxes and subsidies** do not fully transfer to prices; instead, their burden is shared between producers and consumers based on elasticity.
- **Government intervention** often causes deadweight loss, leading to overall inefficiency, especially in cases like price supports and import quotas.
- **Not all intervention is bad**—it can serve objectives beyond efficiency, such as addressing externalities and market failures.
- **Policy design must consider trade-offs** between economic efficiency and broader social goals.

Beyond efficiency

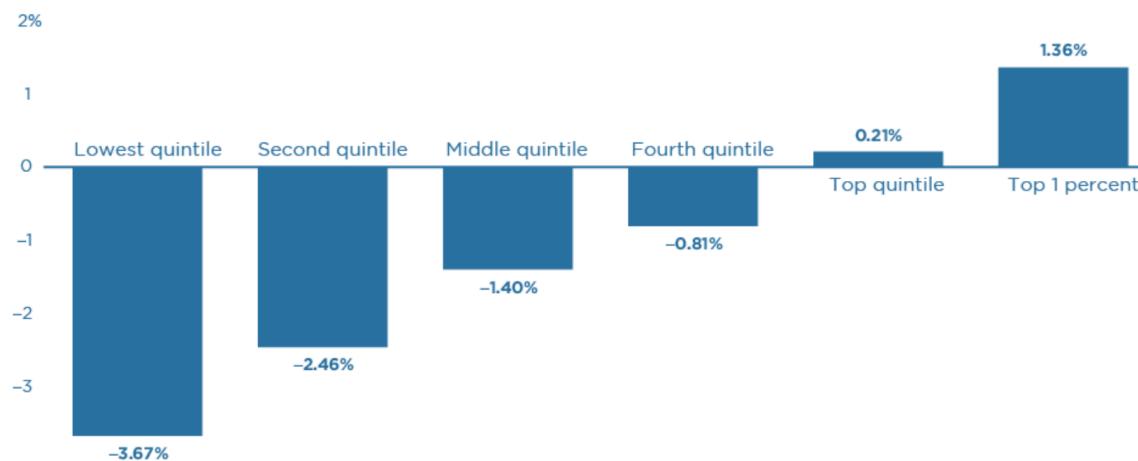
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Figure 6

Trump's fiscal agenda places a greater burden on lower- and middle-income taxpayers

Net distributional effect of TCJA extensions and tariff increases, percent change in after-tax income



Sources: Tax Policy Center (2022) provides the TCJA extension distribution data. Tariff distributions utilize data from Consumer Expenditure Surveys from the US Bureau of Labor Statistics and data on incomes are from the US Treasury.

Peterson Institute for International Economics (2024)

TD

TD: A tax on gasoline

How a \$1-per-gallon tax would affect the price and consumption of gasoline?

- \$3 per gallon on average
- 140 billion gallons per year (bg/yr)

$$Q_d = 209 - 23 \cdot P \quad Q_s = 83 + 19 \cdot P$$

Government must receive \$1.00/gallon

$$Q_d = 209 - 23 \cdot P_d$$

$$Q_s = 83 + 19 \cdot P_s$$

$$Q_s = Q_d$$

$$P_d - P_s = 1$$

TD: A tax on gasoline

$$209 - 23 \cdot P_d = 83 + 19 \cdot P_s$$

Note that $P_d = 1 + P_s$

$$\Rightarrow 209 - 23 \cdot (1 + P_s) = 83 + 19 \cdot P_s$$

$$\Rightarrow 209 - 23 + -23 \cdot P_s = 83 + 19 \cdot P_s$$

$$\Rightarrow 42 \cdot P_s = 103$$

$$\Rightarrow P_s \approx 2.45$$

Then, $P_s = 2.45$ and $P_d = 3.45$.

$$Q_d = 209 - 23 \cdot 3.45 = 129.65$$

$$Q_s = 83 + 19 \cdot 2.45 = 129.55$$

- What is the government revenue?
- What is the deadweight loss?

