Elasticity

Measuring Change

Elasticity? So What?

In Chapters 3-5 we explored **demand** and **supply**.

We explained how **choices** of consumers (producers) **created** demand (supply) **curves** and how demand (supply) curves **adjusted** when willingness and ability to pay (make available) changed.

We explored how supply and demand **created market equilibria** and how those equilibria changed in response to changing demand and supply.

Elasticity? So What?

In chapters 3-5, we explored the concept of **efficiency**.

We also saw how to measure **total surplus** (consumer and producer surplus) in market equilibria. We saw how **total surplus** changes and **deadweight loss** emerges from price controls.

Elasticity, Generally

We have explain why demand curves slope downward (the **Law of Demand**) and why most supply curves slope upward (the **Law of Supply**), but we did not spend a lot of time exploring the **shapes** of these curves.

Elasticity tells us information about how **responsive** consumers or producers are to **changes** in economic parameters. Elasticity is closely related to the **shape of supply and demand curves**.

Elasticity, the Other Answer

The answer to nearly any “why” question in microeconomic is “opportunity cost.”

The answer to nearly any “how much” questions is “it depends on elasticity.”

Opportunity cost is the linchpin of **theoretical** economics; elasticity is our first major empirical (observational) tool.

Elasticity, Abstractly

Elasticity is the term economists use to describe the **responsiveness** of **one** variable **in terms of another** as **measured** by a **ratio** of **percent changes**.

We use **percent change** in elasticities to avoid the issues introduced by different units of measurement and to account for the fact that prices vary widely across goods.

Elasticity, In Formula

Lea's Law of Elasticities (LLoE):

When economists say "The A elasticity of B," that relationship is written in the following formula

$$E_{AB} = \frac{\%\Delta B}{\%\Delta A}$$

Elasticity, Conceptually

Any observations with **quantitative variation** can be an 'elasticity;' that's simply a matter of taking the ratio of the percentage changes.

But not all such 'elasticities' are interesting. Economic relationships, unlike pure mathematical relationships, deeply rely on **causation**. Economists are interested in whether the change in one thing **causes** a change in the other.

Elasticity, More on LLoE

When economists say "The A elasticity of B," that relationship is of the form

$$E_{AB} = \frac{\%\Delta B}{\%\Delta A}$$

Economists are **also** implicitly saying "Changes in A caused the change in B." They're **not merely** correlative.

The [Own] Price Elasticity of [Quantity] Demand[ed]

One of the most common elasticities economists use is “the own-price elasticity of quantity demanded.” Following LLoE, we know that the formula for this important elasticity is

$$E_d = \frac{\%\Delta Q}{\%\Delta P}$$

We call this the “own-price” because it relates quantity of a good to changes in its own price, as opposed to another’s price.

Mathematics of the Elasticity Formula

Recall that **elasticity** is a **ratio** of **percentage changes**. We can find elasticity implicit in variation from a point.

$$E_d = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\frac{(Q_1 - Q_0)}{Q_0}}{\frac{(P_1 - P_0)}{P_0}}$$

The Sign of E_d

Since demand curves are downward-sloping, all [own-] price elasticities of [quantity] demand[ed] will be negative. For this reason, economists usually drop the negative sign and show own-price elasticity in absolute value terms.

Either is fine and easily understood, even if a negative value is *technically* more correct. Just don't be fooled by any sign you see!

Critical Values for E_d

Perfectly Inelastic: $E_d = 0$

Inelastic: $0 < E_d < 1$

Unitary: $E_d = 1$

Elastic: $E_d > 1$

Perfectly Elastic: $E_d = \infty$

Recall:

$$E_d = \frac{\%\Delta Q}{\%\Delta P}$$

If $E_d < 1$, then $\%\Delta P > \%\Delta Q$

If $E_d = 1$, then $\%\Delta P = \%\Delta Q$

If $E_d > 1$, then $\%\Delta Q > \%\Delta P$

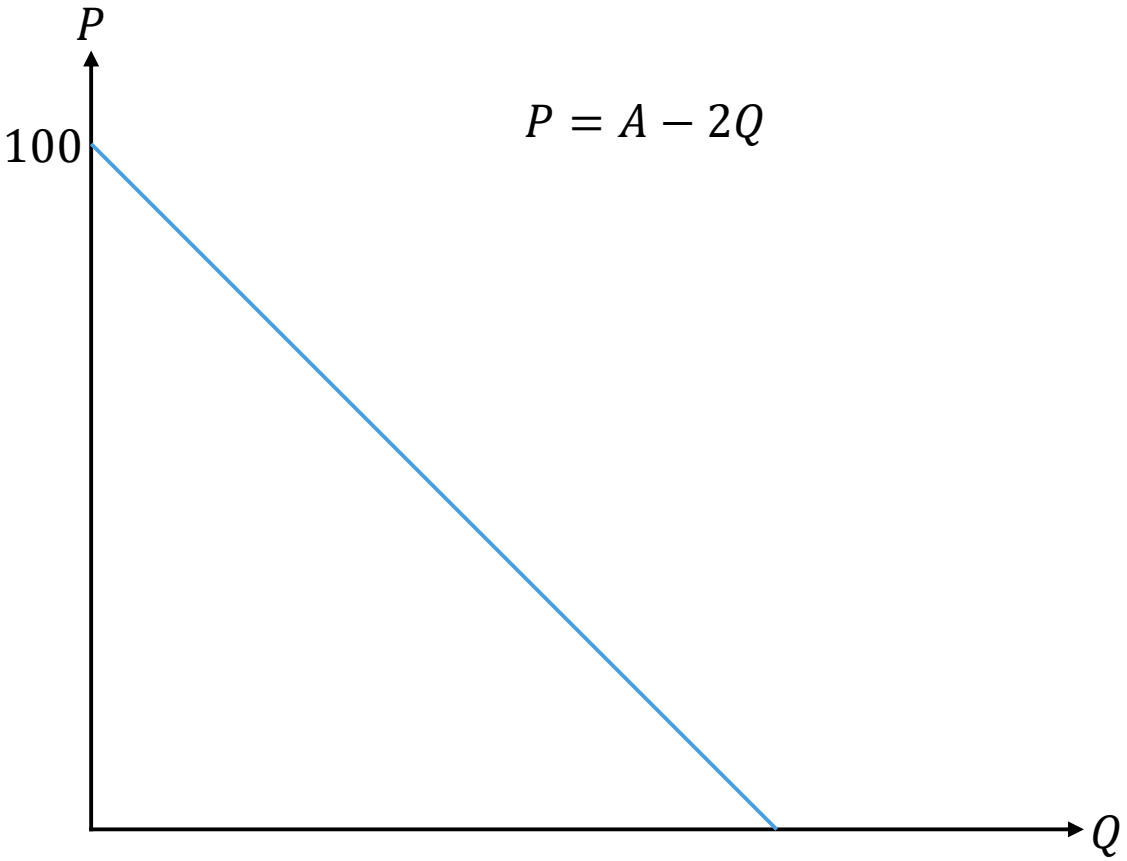
E_d is NOT the Slope of the Demand Curve

$$\frac{\%\Delta Q}{\%\Delta P} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{Q} \times \frac{P}{\Delta P} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

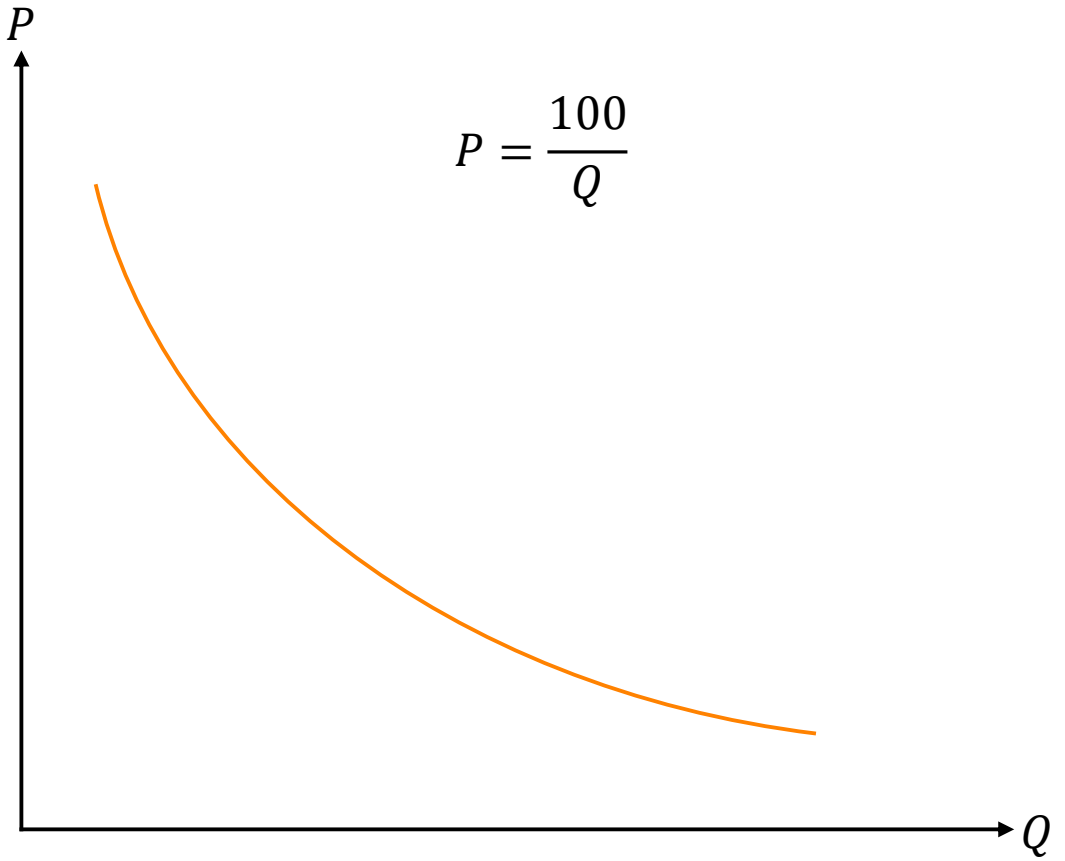
As the changes in P and Q get smaller (closer to zero), we converge toward $\frac{dQ}{dP}$, the inverse of the slope of the curve. So the slope is just one part of the elasticity, not its entirety.

If a number of demand curves **share** a (P, Q), **slope** does explain differences in elasticity **around that point**.

Elasticity: Not Just Slope

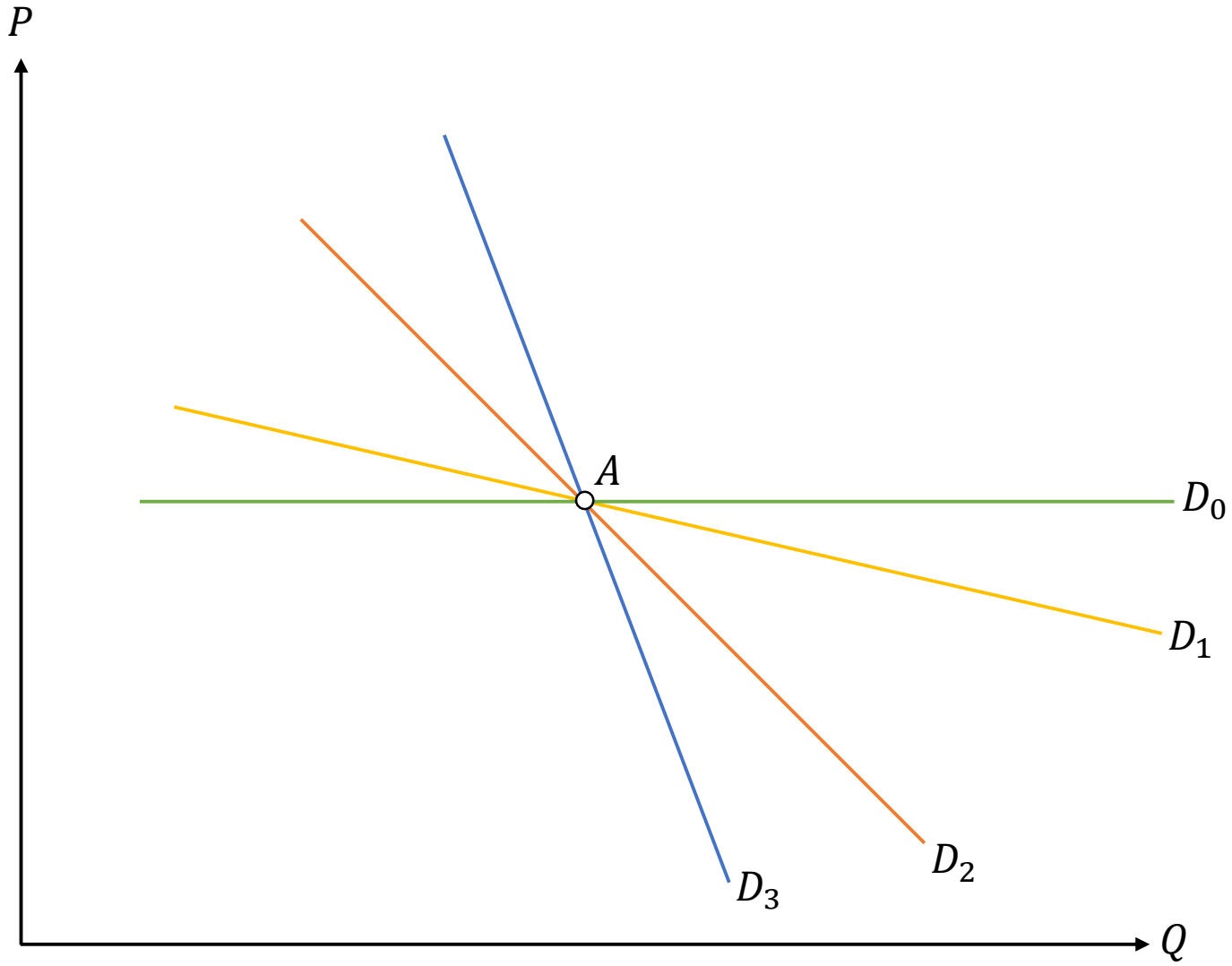


Single slope, Different Elasticities at Every Point



Different Slope at Every Point, the Same Elasticity

Elasticity for Different Demand Curves



What Determines Own-Price Elasticity?

1. **Substitutes** – "proximity" of substitutes; narrowly defined goods have more substitutes, and therefore are more elastic
2. Time period – the "2nd Law of Demand;" think "time to find substitutes"
3. Proportion of Income – smaller proportions mean less elastic (dubious)

The Total Revenue Test

Total revenue is Price times Quantity

$$TR = P \times Q$$

How does TR change as P and Q change?

$$\%\Delta(PQ) = \%\Delta Q + \%\Delta P + (\%\Delta Q \times \%\Delta P)$$

Math for Revenue Changes

$$\frac{\Delta TR}{TR} = \frac{\Delta(PQ)}{PQ} = \frac{(Q+\Delta P)(P+\Delta Q) - PQ}{PQ}$$

$$\%\Delta TR = \frac{PQ + Q\Delta P + P\Delta Q + \Delta P\Delta Q - PQ}{PQ}$$

$$\%\Delta TR = \frac{Q\Delta P}{PQ} + \frac{P\Delta Q}{PQ} + \frac{\Delta P\Delta Q}{PQ}$$

$$\%\Delta TR = \frac{\Delta P}{P} + \frac{\Delta Q}{Q} + \left(\frac{\Delta P}{P}\right)\left(\frac{\Delta Q}{Q}\right)$$

Total Revenue: Summing Up

Will a firm make higher revenue charging a higher price on a lower quantity, or by selling a higher quantity at a lower price?

It. Depends. On. Elasticity.

For goods with elastic demand, higher prices LOWERS revenue.

For goods with inelastic demand, higher prices RAISES revenue.

Other Interesting Demand Elasticities

LLoE!

Income elasticity of Quantity Demanded

$$E_Y = \frac{\%\Delta Q}{\%\Delta I}$$

Superior if $E_Y > 1$

Normal if $0 < E_Y < 1$

Inferior if $E_Y < 0$

Other Interesting Demand Elasticities

LLoE

Cross-Price Elasticity of Quantity Demanded

$$E_{ab} = \frac{\%\Delta Q_x}{\%\Delta P_y}$$

Substitutes if $E_{ab} > 0$

Complements if $E_{ab} < 0$

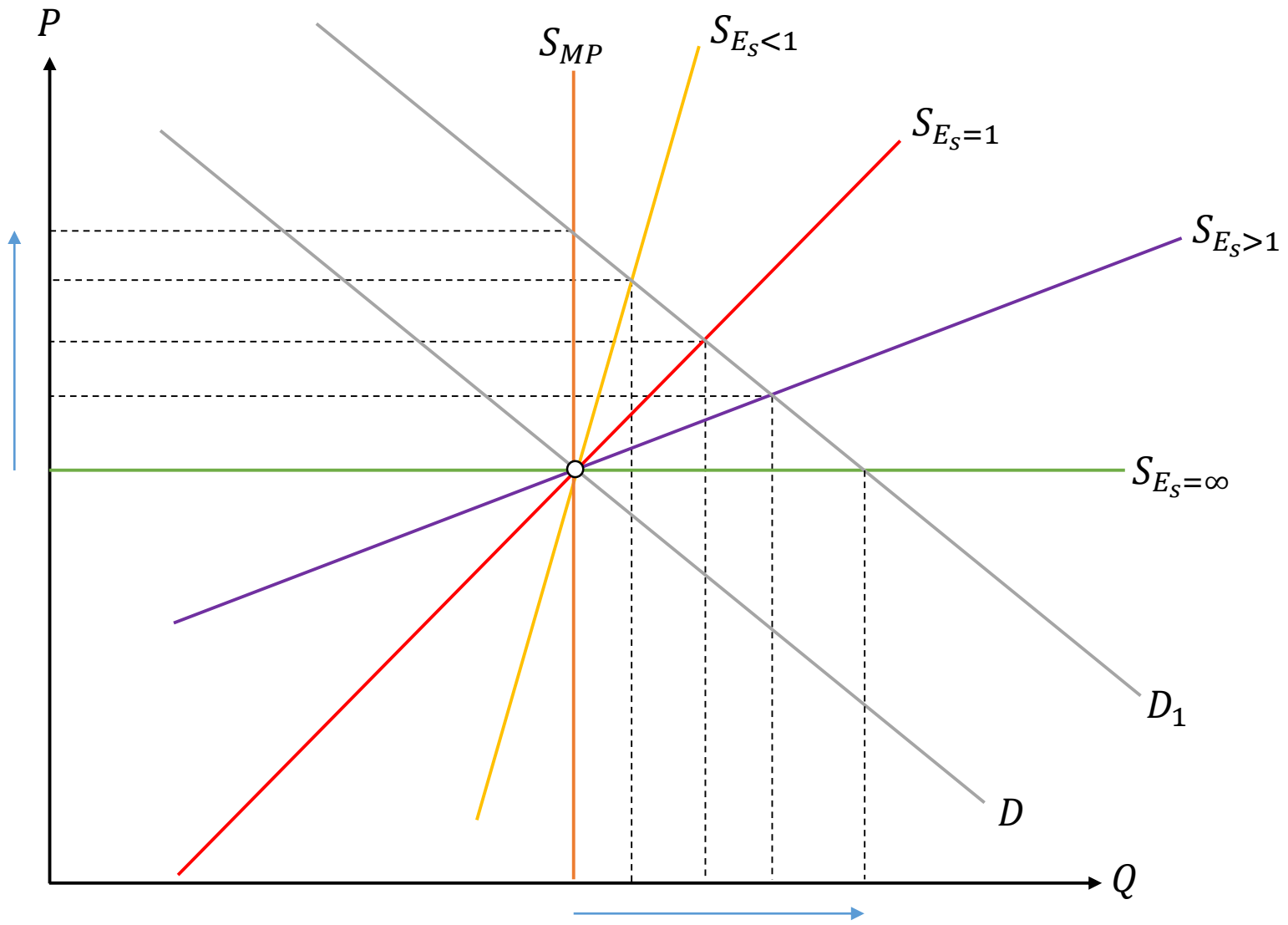
[Price] Elasticity of [Quantity] Supply[ied]

LLoE!

$$E_s = \frac{\%\Delta Q}{\%\Delta P}$$

If $\%\Delta P > \%\Delta Q$, then $E_s < 1$ and Inelastic
If $\%\Delta P = \%\Delta Q$, then $E_s = 1$ and Unitary elastic
If $\%\Delta Q > \%\Delta P$, then $E_s > 1$ and Elastic

Elasticity Graphs



What Affects Elasticity of Supply?

1. Time — **market period**, **short** run, **long** run

2. Marginal Cost — production capacity and input availability
   a. If a firm wants to **expand output**, what will happen to cost per unit at the margin?
   b. Is it even **possible** to expand output?

A Vocabulary of Taxation, part 1

Legal incidence of a tax – who, legally, must pay or remit the tax to the taxing authority

Economic incidence of a tax – which party bears which portion of the revenue and the deadweight loss of a tax

A Vocabulary of Taxation, part 2

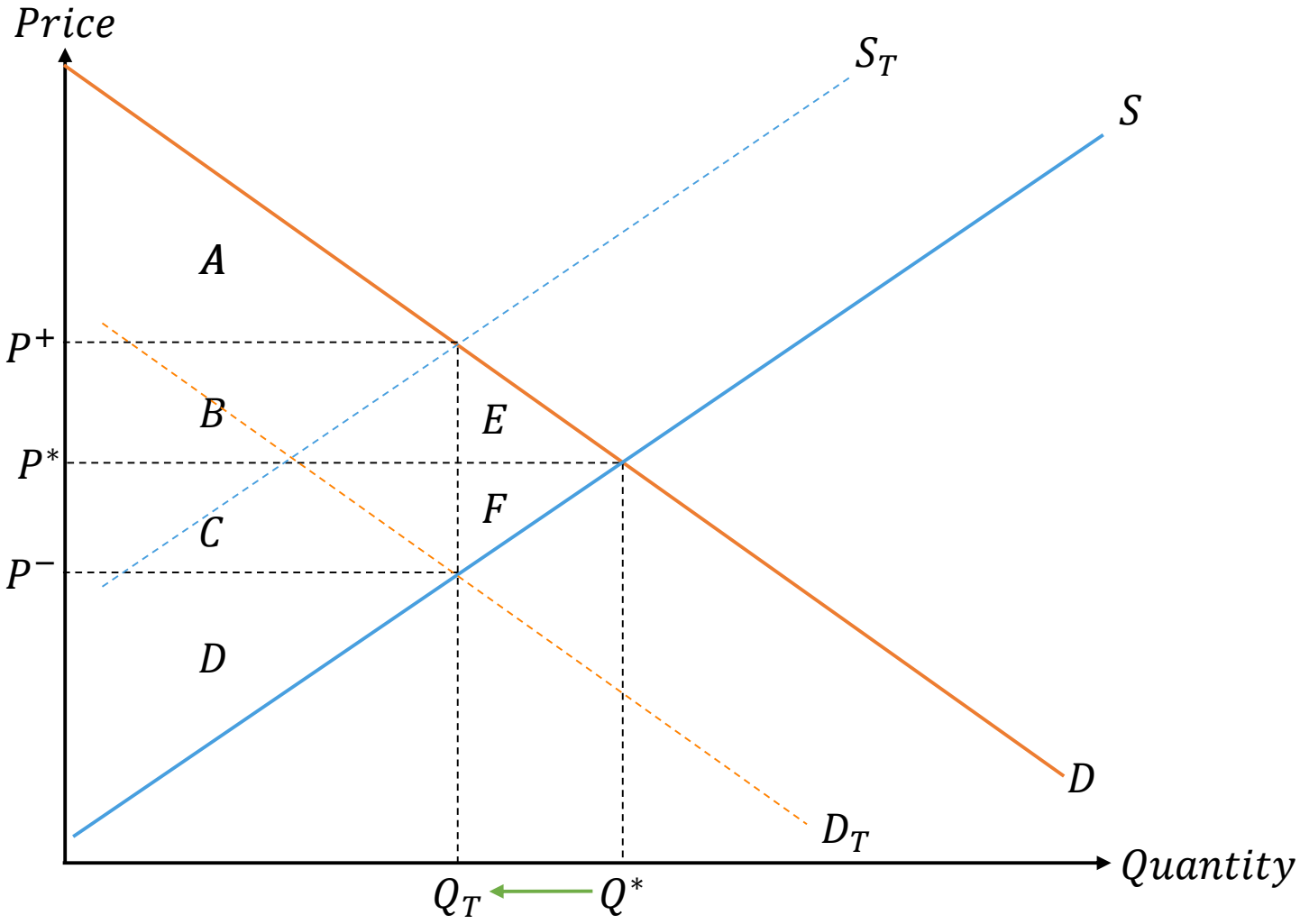
Ad valorem tax – a percentage charged on the market value of the good transacted

- Sales tax (in TN, a brutal 9.5%)
- Excise tax on particular goods, like alcohol, tobacco, etc.

Lump sum tax – a flat amount charged for consuming something

- Bottle deposits
- Tolls

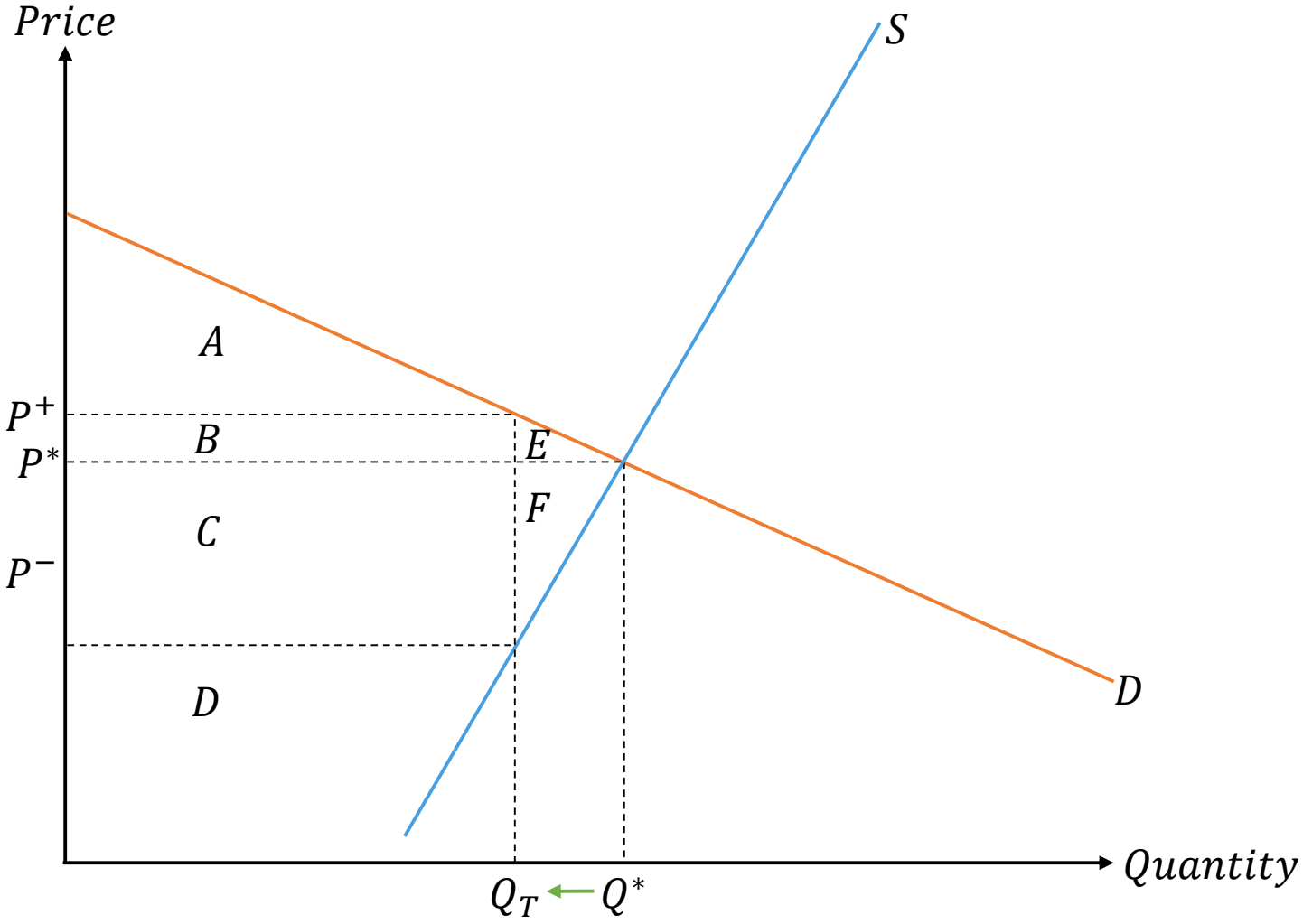
Modeling a Tax with Supply and Demand



Before the Tax:
CS = A+B+E
PS = C+D+F

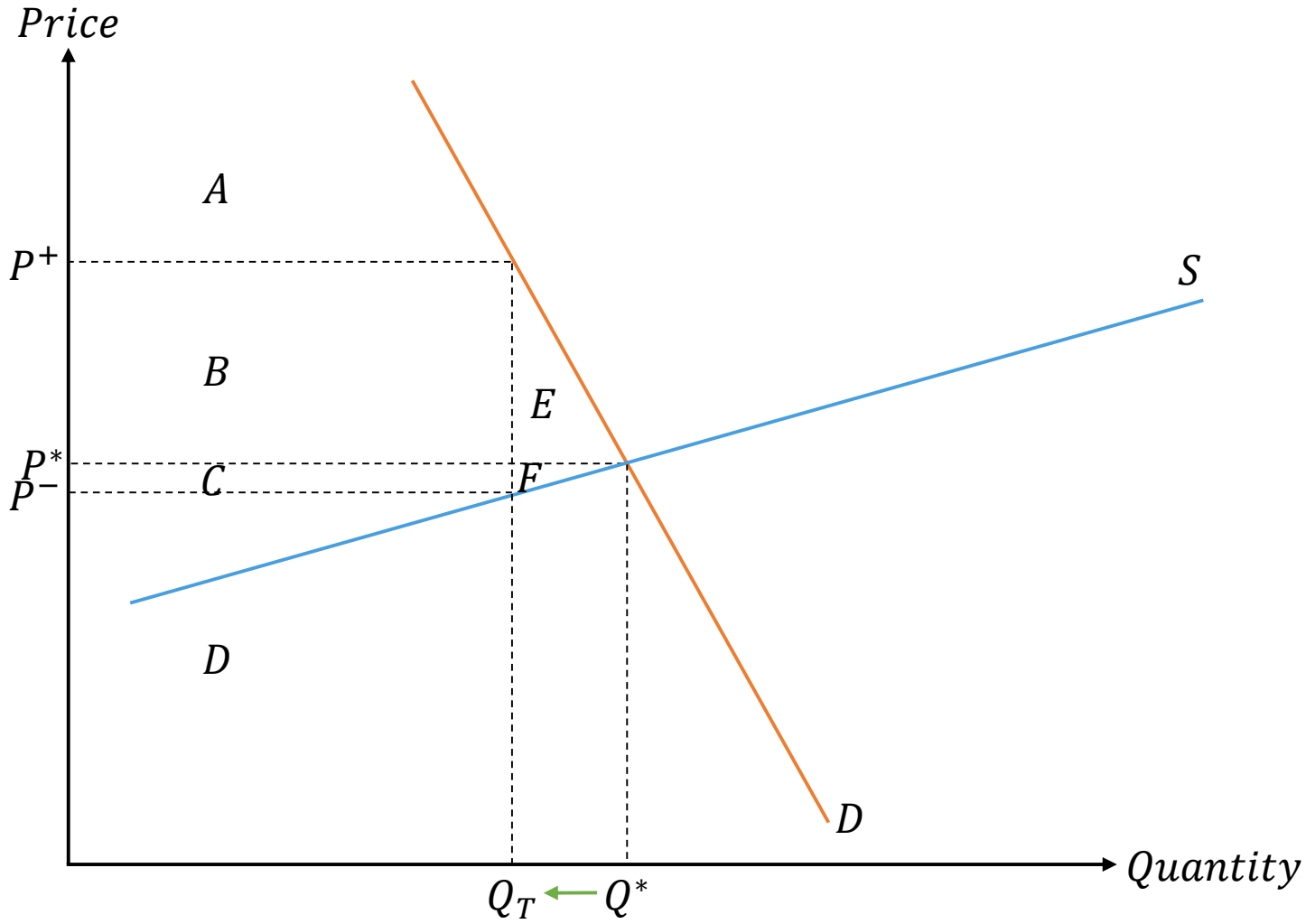
After the Tax:
CS = A
PS = D
Revenue = B+C
DWL = E+F

Economic Incidence Differences



The distance between $P^+$and P^- is the same as on the previous slide

Economic Incidence Differences



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Summing Up

The economic incidence, or economic burden, of taxation manifests in lost surplus. This surplus is lost to **tax revenue** (a transfer to the government) and **deadweight loss**.

The **economic incidence** falls more heavily on the **relatively price inelastic curve**—supply or demand.

Summing Up

Markets where the good is **both** elastically supplied and elastically demanded will generate **very little revenue** and **significant deadweight loss**, due to tremendous reductions in quantity.

Markets where the good is **both** inelastically supplied and inelastically demanded will generate **large revenue** and **very little deadweight loss**, due to very small reductions in quantity.