ECONOMICS Lecture 11
The Second Law of Demand

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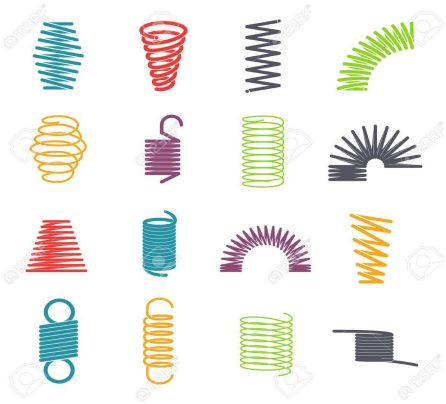
Topics

- The Shape of Demand Curve
- Total Revenue and Elasticity
- Revenue Maximization Rule
- The Second Law of Demand

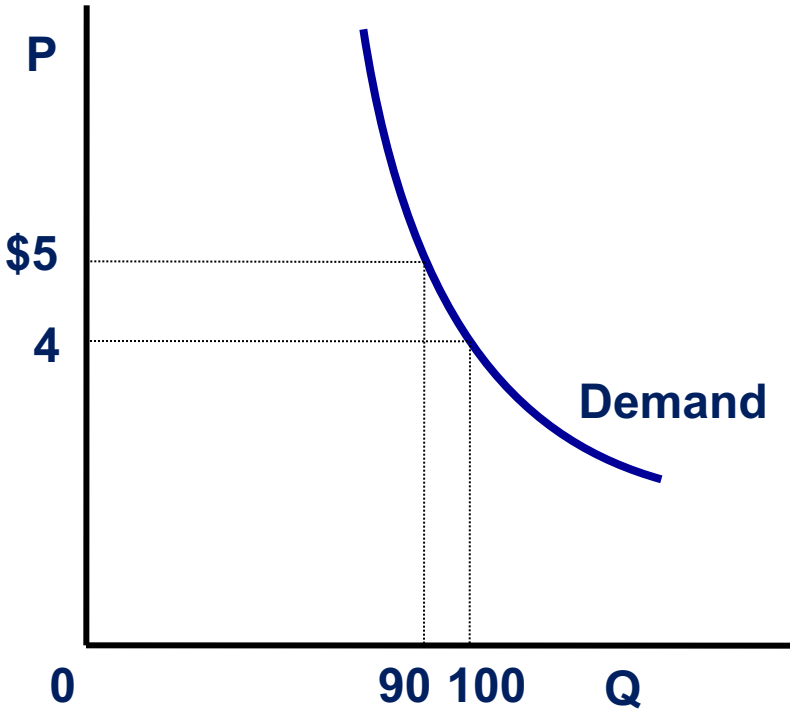


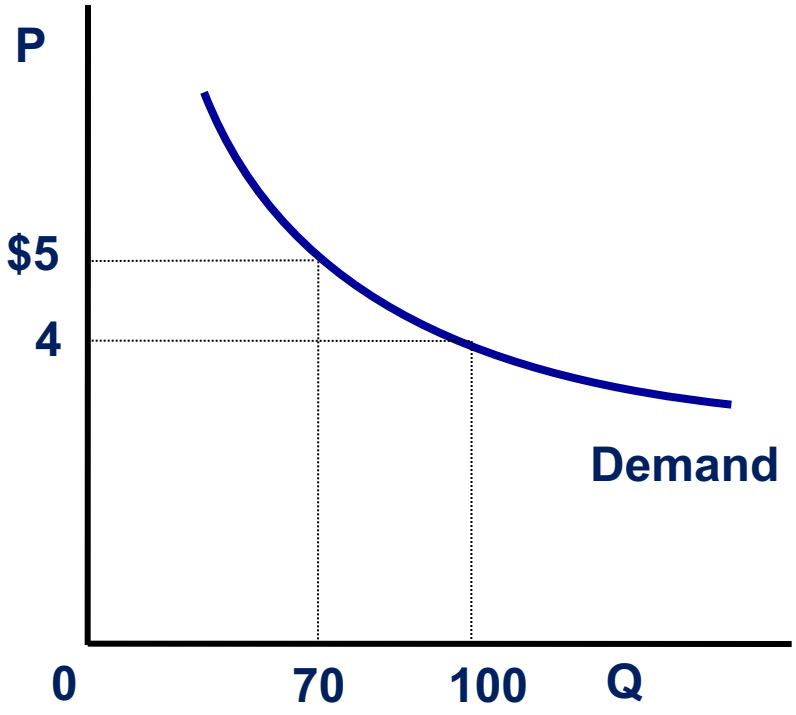
This lecture studies the shape of demand curve, the concept of price elasticity, and its application in business pricing and revenue. From public policy perspective, market demand curves become more elastic as time elapses, rendering public policies less effective.

The Shape of Demand Curve

- The demand curve indicates the inverse relationship between price and quantity demanded of a good.
- For the same good, different individuals display distinct demand schedules. Why?
- At aggregate level, market demand curve for a good also changes shape from time to time. Why?
- More importantly, what's the take-home message from different shapes of the demand curves?
- Can we apply an equation to model the demand curve?

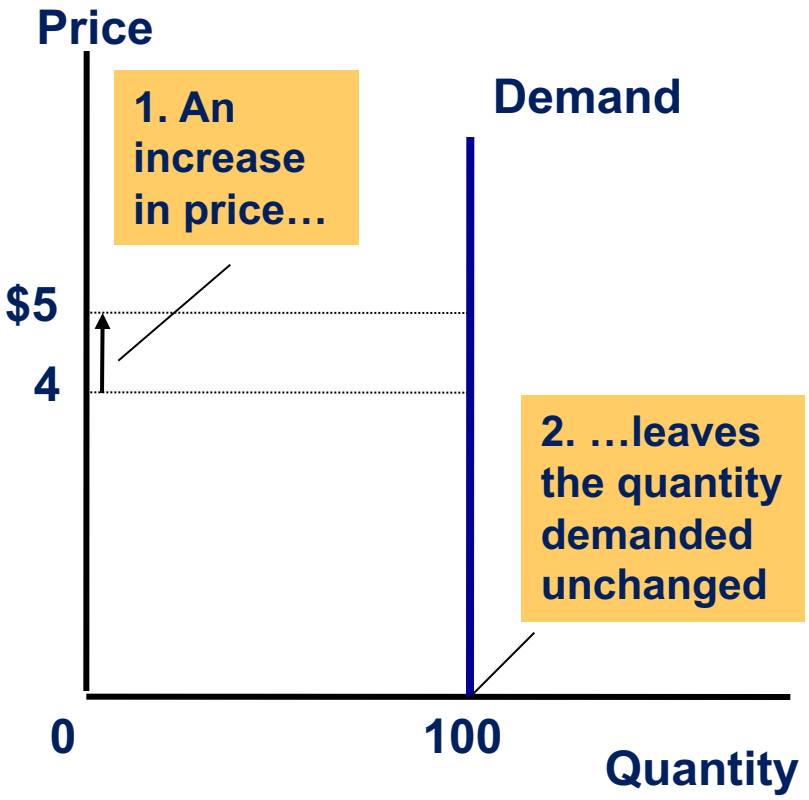
The Downward-Sloping Demand Curves



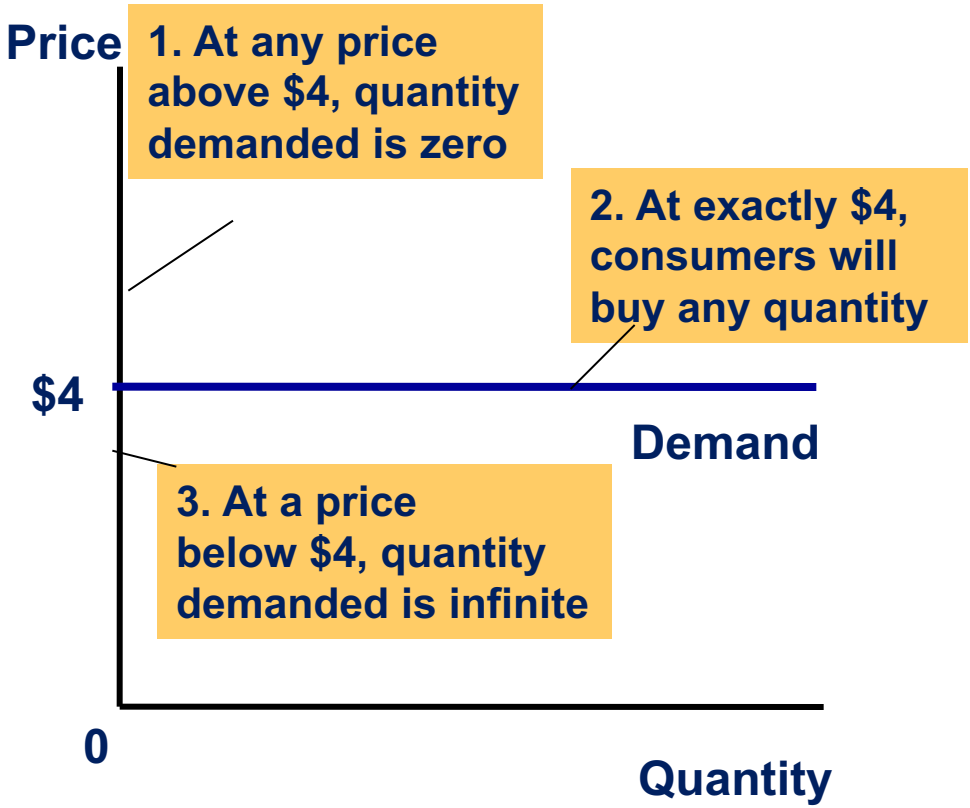


- What is the difference between these demand curves?
- If price drops, what happen to quantity demanded?

Two Extreme Demand Curves



Vertical demand curve Q=100



Horizontal demand curve P=$4

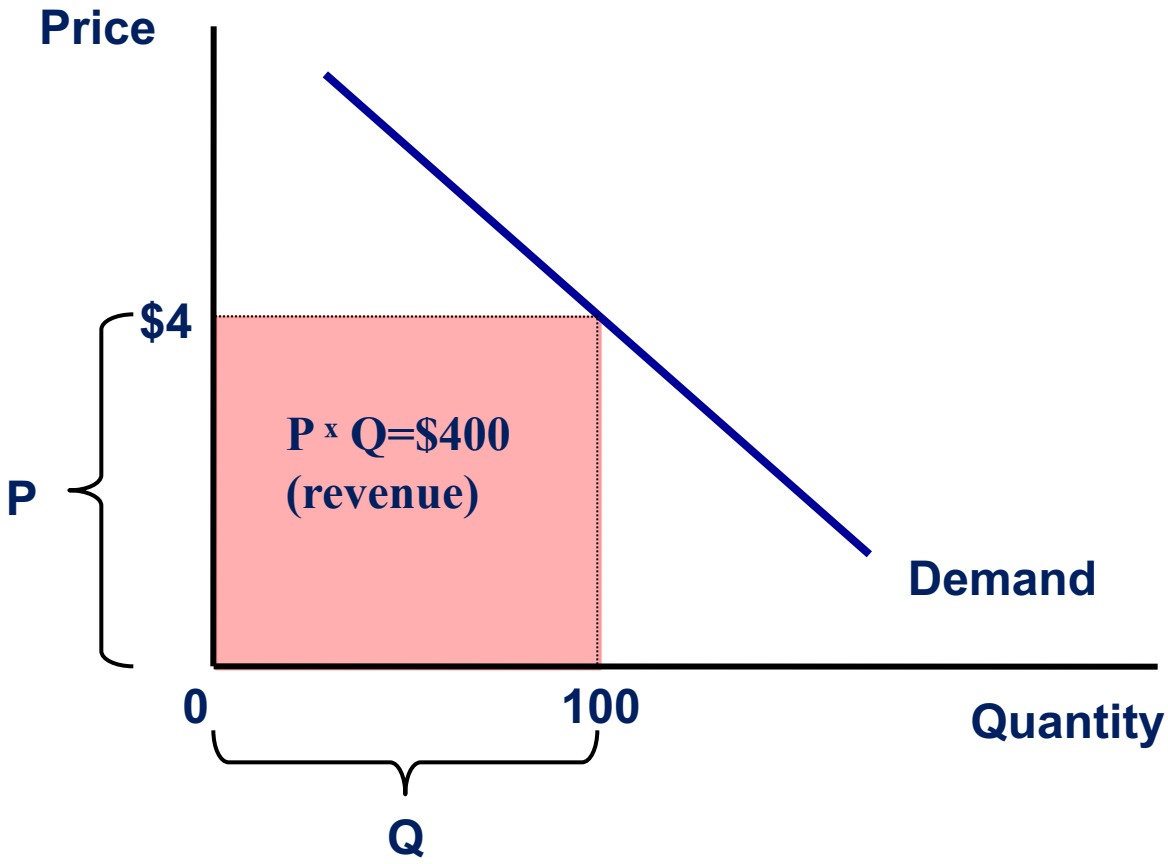
The Price Elasticity of Demand

- Along the demand curve, how much will the quantity demanded of a good respond to a change in the price of that good?
- **Price Elasticity of Demand**: A measure of the degree of responsiveness of quantity demanded to a change in price.
- Calculation: the percentage change in quantity demanded over the percentage change in price. Unit-free measure.
- Formula: $E_P = (\Delta Q/Q)/(\Delta P/P) = (\Delta Q/\Delta P)*(P/Q)$
- For simplicity, omit the negative sign and take the absolute value.
- Now economists can calculate the elasticities of the points along the entire demand curve to estimate the market resilience.

Demand Curve and Sales Revenue

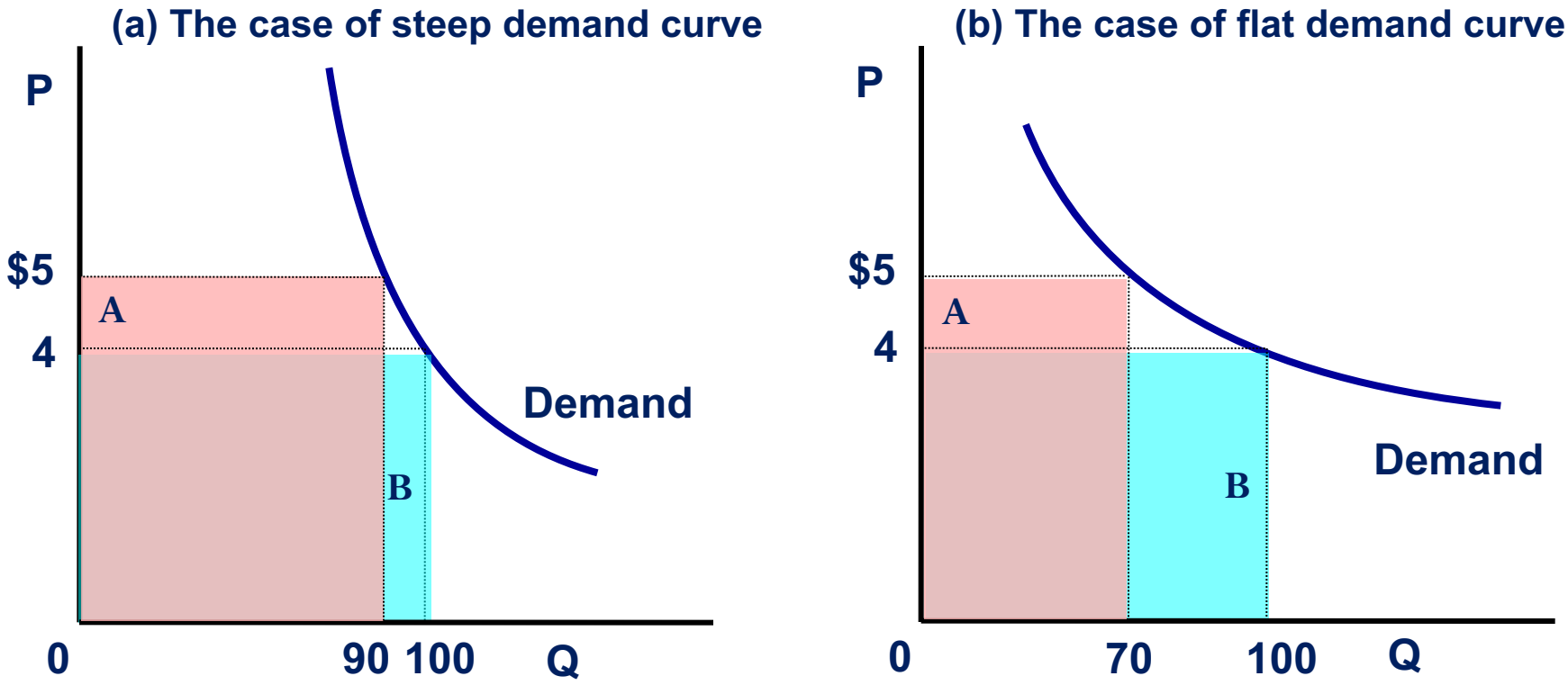
- From any demand curve available, there is a one to one relationship between price and quantity demanded.
- Business persons care about their market demand curve mainly because it's useful for predicting sales revenues.
- How would a change in price affect the sale revenue?
- **Total Revenue (TR):** the amount of money paid by the buyers and received by the sellers for the goods and services in transaction.
- How do we calculate total sales revenue? TR=?
- Price of the good times the quantity sold (P*Q).

Demand Curve and Total Revenue



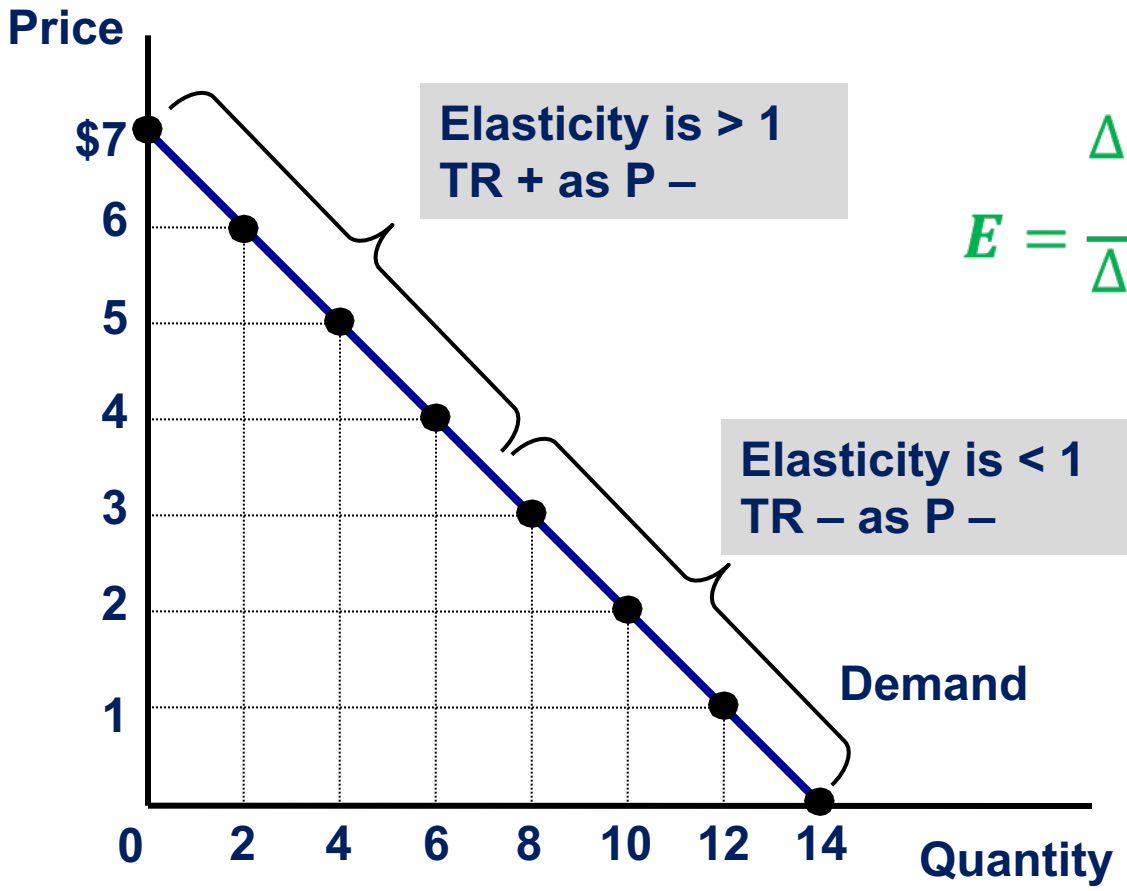
The total amount paid by buyers, and received as revenue by sellers, equals the area of the box under the demand curve, *P* × *Q*. Here, at a price of $4, the quantity demanded is 100, and total revenue is $400.

Total Revenue and Price Changes



- In panel (a), an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 90. Total revenue rises from $400 to $450.
- In panel (b), an increase in the price from $4 to $5 causes the quantity demanded to fall from 100 to 70. Total revenue falls from $400 to $350.

Linear Demand, Elasticity & Sales Revenue



$$E = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P}\frac{P}{Q}$$

- Total Revenue = (Price * Quantity Sold). The size of the rectangular area.
- In the upper range of the D, what is the change of TR moving from ($5, 2) to ($4, 6)?
- In the lower range of the D, what is the change of TR moving ($2, 10) to ($1, 12)?

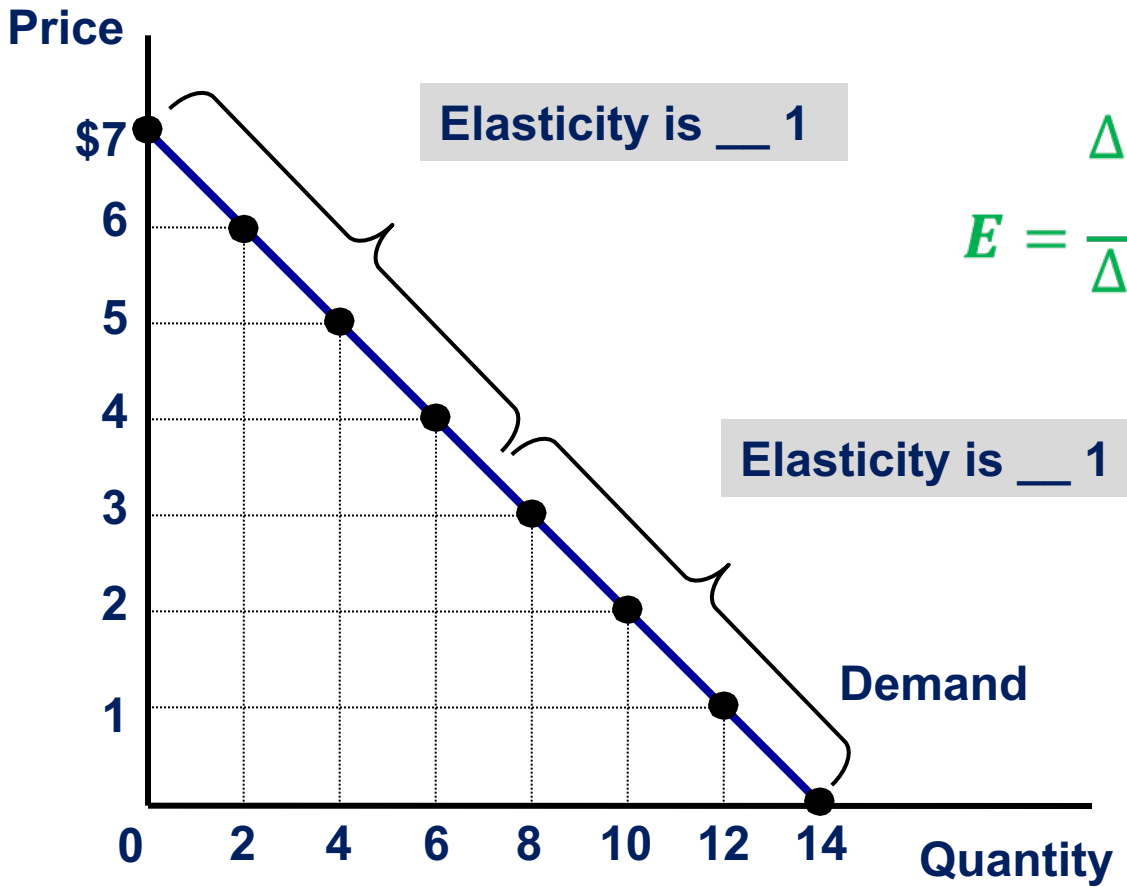
Linear Demand, Elasticity and Total Revenue

Price	Quantity	Total Revenue (Price x Quantity)	Percentage Change in Price	Percentage Change in Quantity	Elasticity	Description
$7	0	$0	15	200	13.0	Elastic
6	2	12	18	67	3.7	Elastic
5	4	20	22	40	1.8	Elastic
4	6	24	29	29	1.0	Unit elastic
3	8	24	40	22	0.6	Inelastic
2	10	20	67	18	0.3	Inelastic
1	12	12	200	15	0.1	Inelastic
0	14	0				

a. **From $7 to $4, a price reduction leads to an increase in TR.**
b. **From $3 to $0, a price reduction leads to an decrease in TR.**
c. **At price $4 or $3, a price change leaves TR unchanged.**

Note: The elasticity calculation in the table takes the midpoint between two points, which is not necessary for a linear demand but necessary for a nonlinear demand.

Elasticity of Linear Demand Function



$$E = \frac{\Delta Q / Q}{\Delta P / P} = \frac{\Delta Q}{\Delta P}\frac{P}{Q}$$

The slope of a linear demand curve is constant, but its elasticity is not.
The demand schedule was used to calculate the price elasticity of demand.
At points with a low price and high quantity, the demand curve is inelastic.
At points with a high price and low quantity, the demand curve is elastic.

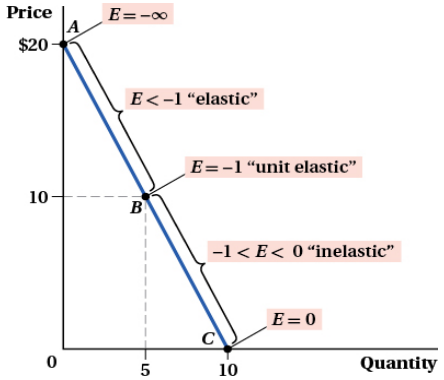
Range of Price Elasticity of Demand

Elasticity range (same D)

a. Q_D is elastic: $|E| > 1$

b. Q_D is inelastic: $|E| < 1$

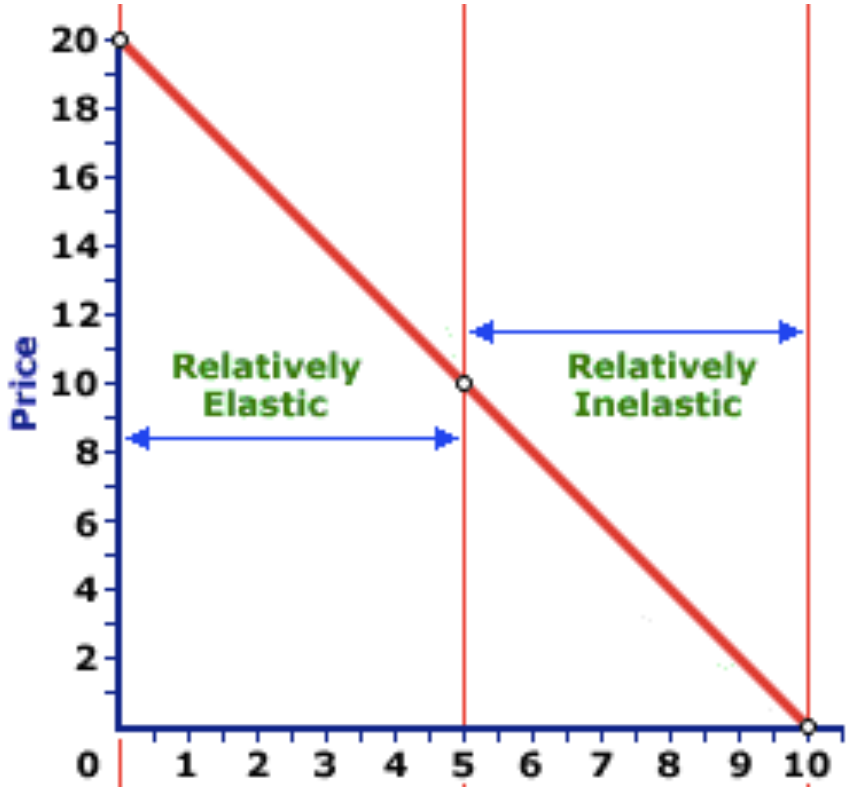
c. Unit price elasticity: $|E| = 1$

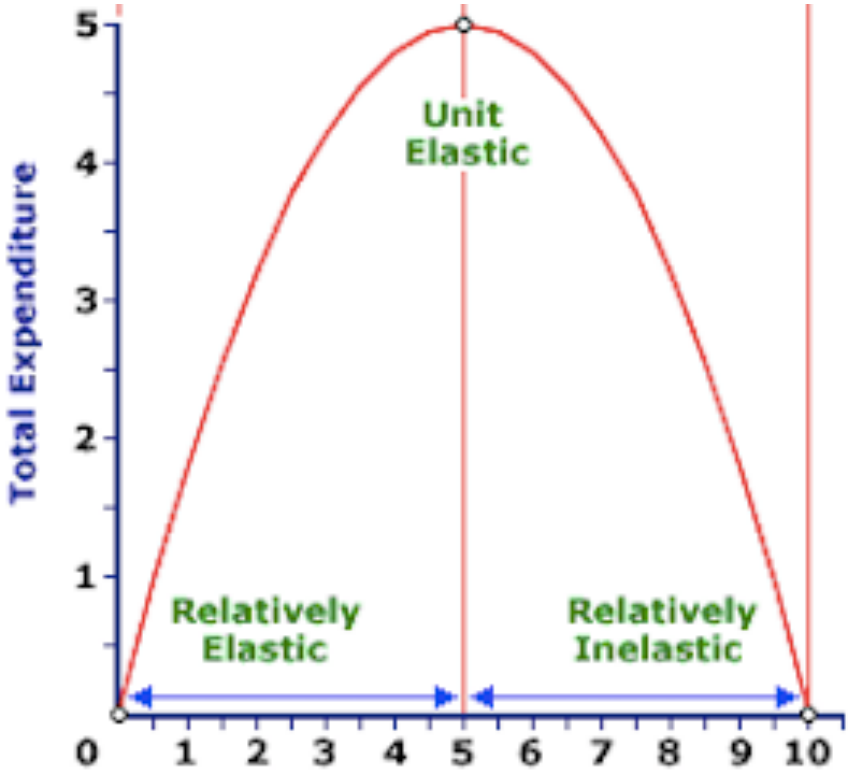


d. The flatter the demand curve, the greater the elasticity!

- Elasticity applies to different ranges along the same demand curve as well as to comparisons among different demand curves.
- Elastic demand curve: Quantity demanded responds substantially to changes in price. Consumers are price sensitive.
- Inelastic demand curve: Quantity demanded responds only slightly to changes in price. Consumers are price insensitive.

Price Elasticity and Total Revenue





a. Demand equation: $P=-2Q+20$; Price elasticity $E_D=0.5P/Q$
b. Total Revenue=$PQ=(-2Q+20)Q=-2Q^2+20Q=-2Q(Q-10)$
c. TR is maximized when $E_D=1$. $TR^*=50$ when $P^*=10$ and $Q^*=5$.

Price Elasticity and Total Revenue

- When demand is inelastic ($|E| < 1$), price and total revenue move in the same direction.
- When demand is elastic ($|E| > 1$), price and total revenue move in opposite directions
- If demand is unit elastic ($|E| = 1$), total revenue remains constant when the price changes.
- Conclusion: Depending on the location of the demand schedule, a firm can charge the price accordingly to maximize total revenue when the price elasticity of demand is equal to one. However, a firm's goal is not to maximize revenue but profit, which deducts costs from its revenue.

Policy Application: Tobacco Consumption

- No doubt, people reduce smoking in response to increases in the price of tobacco product. In 1999, a World Bank review concluded that, all else being equal, price rises of about 10% would on average reduce tobacco consumption by about 4% in developed countries and about 8% in developing countries. What are the E_p for two groups of countries?
- In their 2003 meta-analysis reviewing 86 studies published to the year 2001 which examined the price elasticity of demand for tobacco products, Gallet and List found a mean price elasticity of –0.48, meaning that, on average, a 10% increase in price will be followed by a decrease in consumption of 4.8%.
- The review conducted by the International Agency for Research on Cancer published in 2011 concluded that studies on the impact of price increases on aggregate demand in high income countries on average find price elasticity of about–0.4, with most estimates from the US and UK falling in a relatively narrow range between –0.2 and –0.6.

https://www.tobaccoinaustralia.org.au/chapter-13-taxation/13-1-price-elasticity-of-demand-for-tobacco-produc

Estimates of Price Elasticity

- Statistical studies show that cigarettes seem to have an inelastic demand in the area of current price. Why?
- The total community demand for beer and wine appears to be elastic in the range of observed prices.
- However, classification of commodities by elasticities at various prices is difficult; furthermore, the classification would depend upon the particular prices at which the elasticity was being measured.

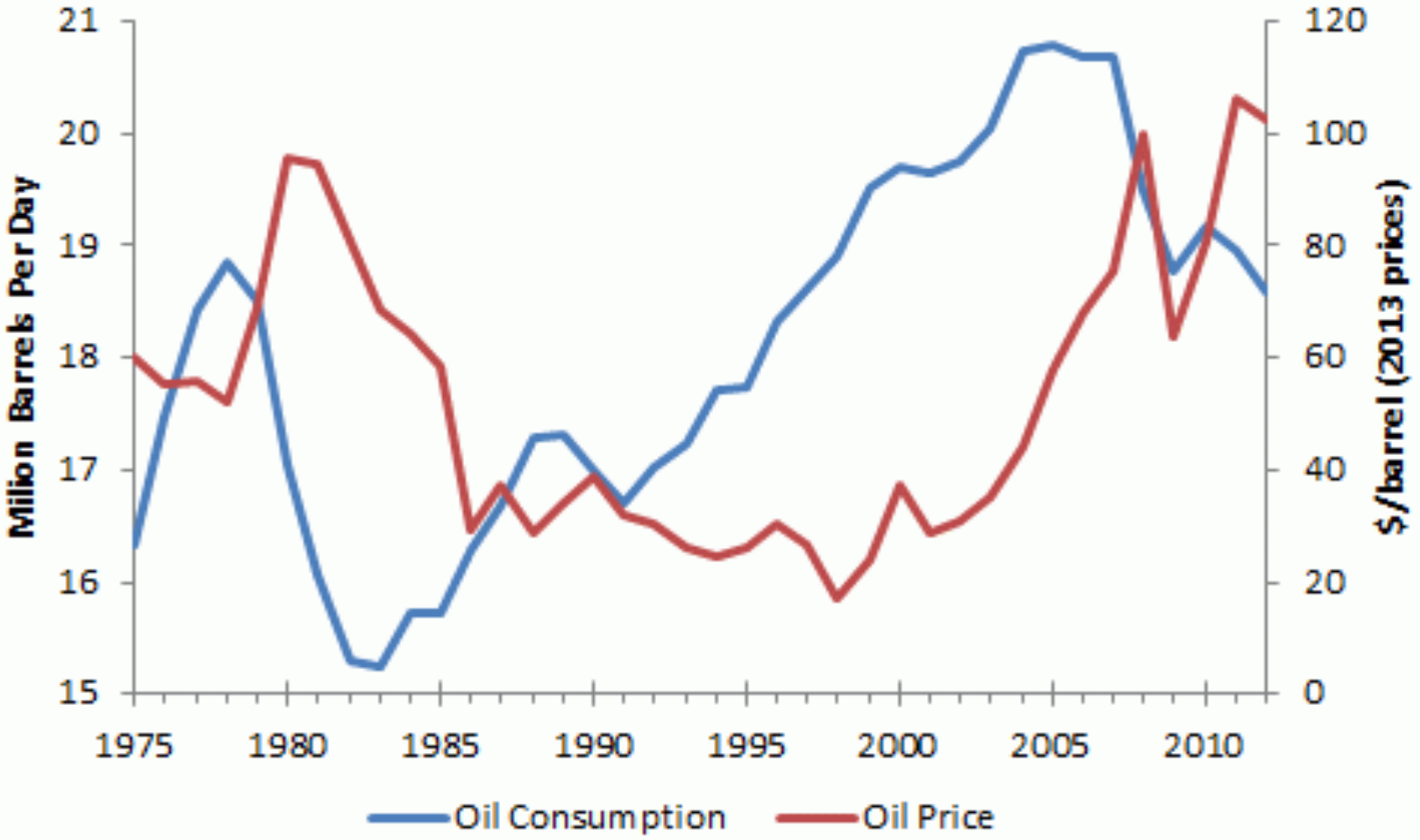
Determinants of Price Elasticity

- Availability of close substitutes: goods with close substitutes – more elastic demand. Necessities – inelastic demand; Luxuries – elastic demand. Why?
- Definition of the market: narrowly defined markets – more elastic demand. Why?
- Time horizon: demand is more elastic over longer time horizons. Why?
- Challenging question: would the demand curve be linear or nonlinear in reality? What factors govern the shape?

The Second Law of Demand

- **The Second Law of Demand** states that demand is more responsive to price in the long run than in the short run, reflecting that searching for substitutes takes time and can be very costly.
- Initially, when the price of a certain good increases or decreases, consumption does not change very drastically. However, when consumers are given more time to react to the change in price, consumption can either increase or decrease very dramatically.
- When the price of a good rises, in the short run, consumer's quantity demanded will fall, all else equal. The law of demand.
- In the long run, consumers can spend more time looking for alternatives and substitutes, which results in a more sensitive demand schedule.

Comparing Oil Prices and Consumption in the US

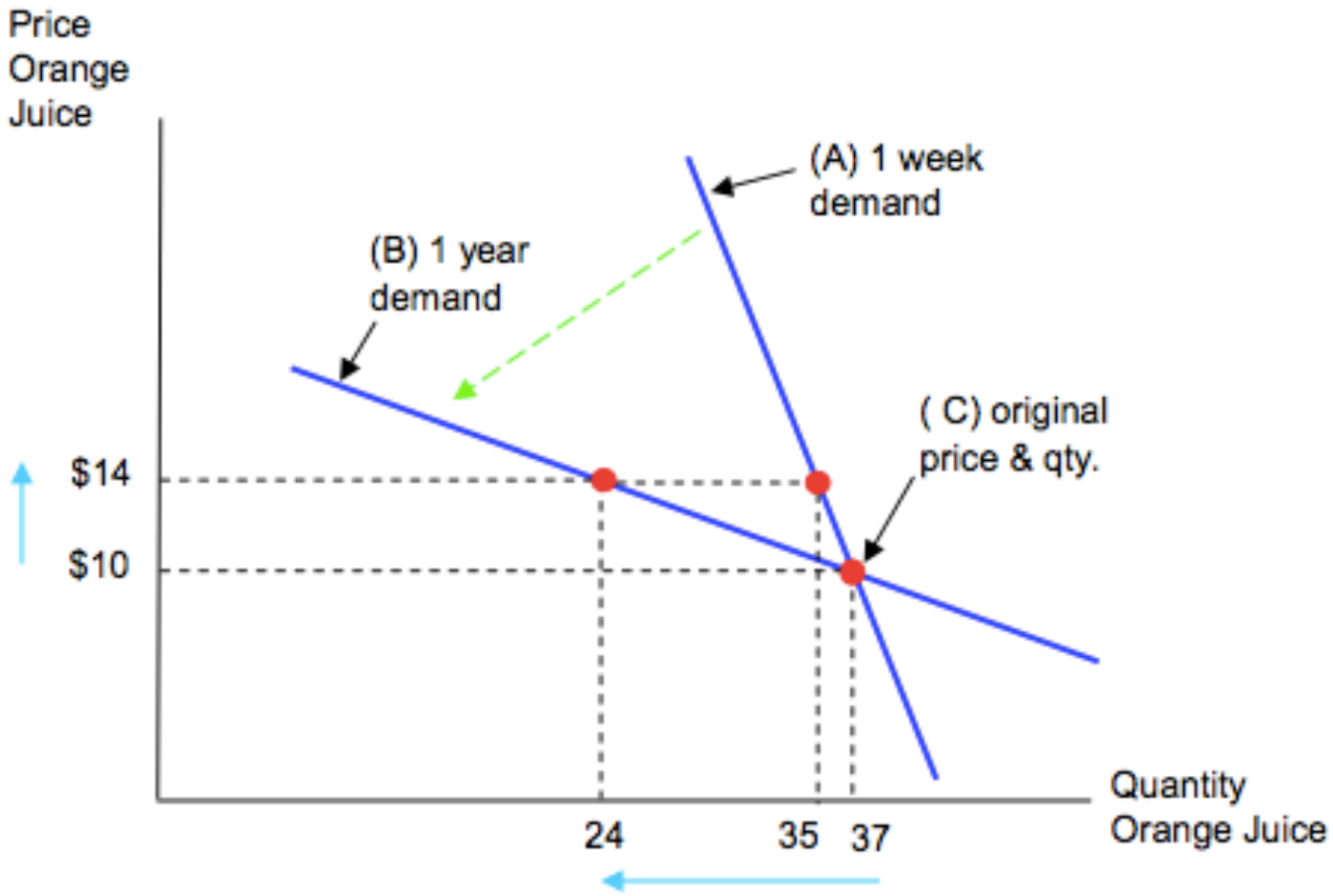


Notes: Oil consumption is total US consumption of crude oil and liquids fuels (includes biofuels)
Oil price is average crude oil acquisition cost paid by US refiners (March 2013 prices using CPI)

Source: EIA Data Query Tool

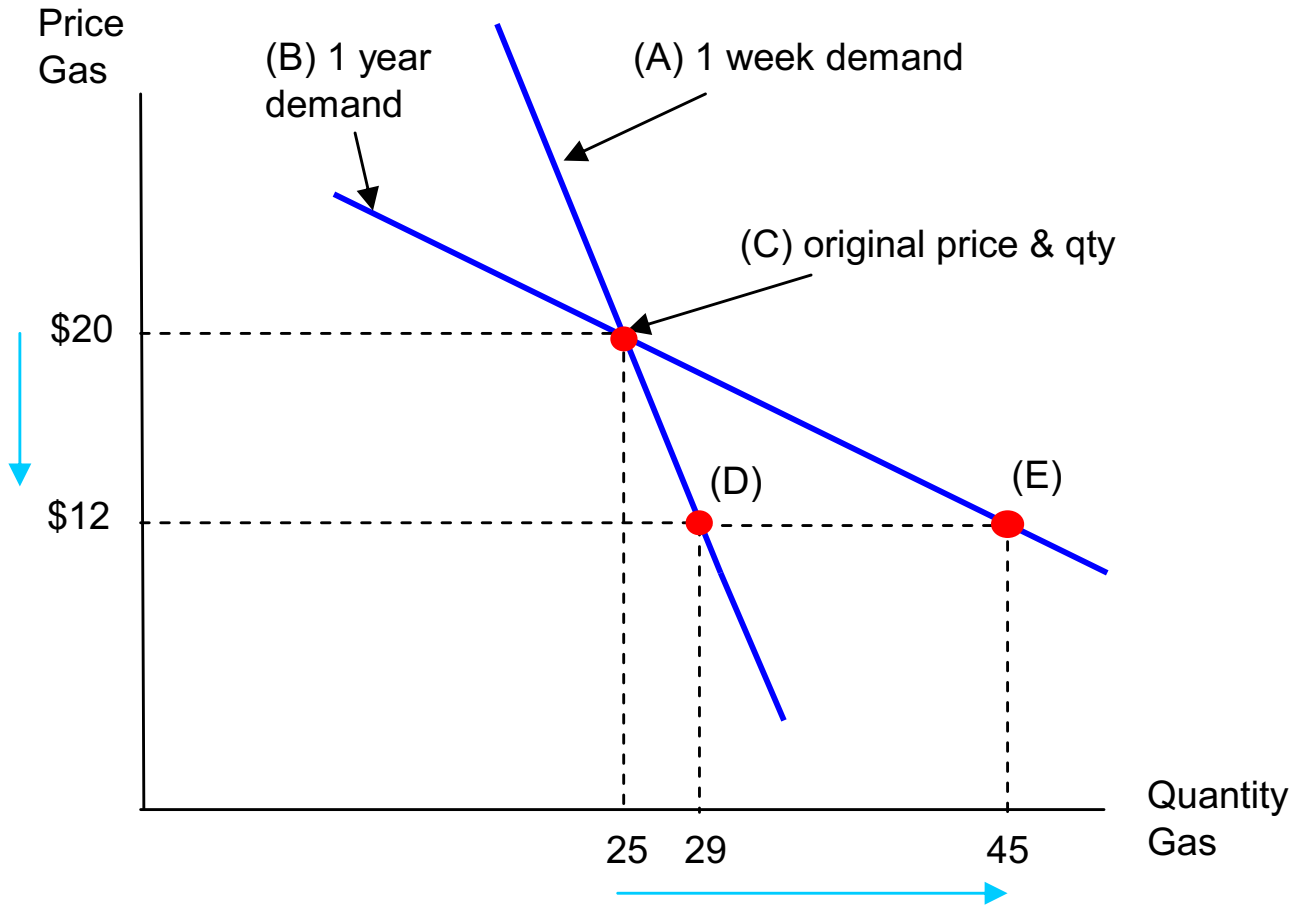
http://shrinkthatfootprint.com/americans-drivers-emitting-less

The Second Law of Demand: P+



The figure shows when the price rises and how the demand for a good, such as orange juice changes in the short run (A) and in the long run (B). The flatter, or more "elastic" demand curve (B) is more reactive to the change in price.

The Second Law of Demand: P–



The figure shows when the price falls and how the demand for a good, such as gasoline changes in the short run (A) and in the long run (B). The flatter, or more "elastic" demand curve (B) is more reactive to the change in price.

Pitfalls of Elasticity Analysis

- Businesses rely on elasticity models for strategic pricing and advertising. They employ tons of data to analyze consumer demand information and estimate the total revenue under different pricing strategies and plans.
- Governments resort to elasticity models when designing public policies in promoting social welfare. For example, taxation policy that can discourage certain types of bad consumption.
- However, such practices may not work at all in the following cases:
  1. For new products introduced or new markets entered (no data)
  2. Consumers' responses to the policy can render the policy ineffective and may result in unintended consequences

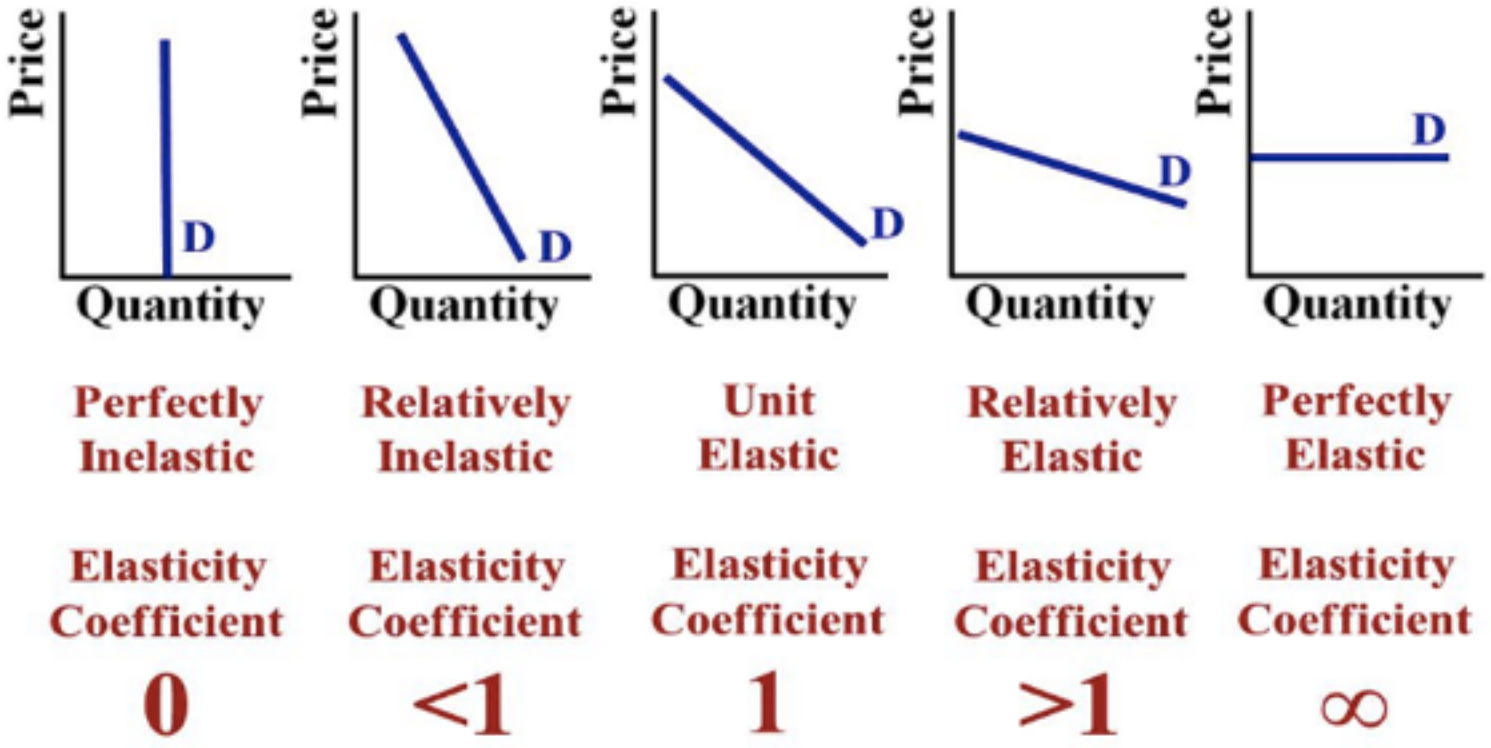
References

[1] N. Mankiw, Principles of Microeconomics, 8th edition. South-Western

[2] Pindyck & Rubinfeld, Microeconomics, 8th edition. Prentice Hall

[3] Goolsbee, Levitt & Syverson (2020) Microeconomics, 3e, Worth

[4] https://www.aeaweb.org/research/uniform-taxes-pennyslvania-liquor-stores



Appendix: Elasticity Family

- Price Elasticity of Demand $E_D = (\Delta Q_D/Q_D)/(\Delta P/P)$
- Price Elasticity of Supply $E_S = (\Delta Q_S/Q_S)/(\Delta P/P)$
- Income Elasticity of Demand: the ratio of the percentage change in quantity demanded to the corresponding percentage change in consumer income. $E_I = (\Delta Q_D/Q_D)/(\Delta I/I)$
  - Inferior good: negative income elasticity ($E<0$)
  - Normal good: positive income elasticity ($E>0$)
  - Necessity good: small income elasticity ($0<E<1$)
  - Luxury good: income elasticity greater than one ($E>1$)
- Cross-Price Elasticity of Demand: the ratio of the percentage change in one good's quantity demanded to the percentage change in the price of another good. $E_C=(\Delta Q_X/Q_X)/(\Delta P_Y/P_Y)$