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CHAPTER 3

Elasticity and Its Applications

One number that measures how much quantity responds to price, and turns the law of demand into a practical tool.

What this chapter covers



3.2–3.3 The core idea

- Price elasticity of demand
- Elastic vs. inelastic
- Elasticity and total revenue



3.4–3.5 More elasticities

- Income & cross-price elasticity
- Price elasticity of supply
- Corrective (sin) taxes



3.6–3.7 Evidence

- Case: cigarette taxes
- Empirical: gasoline demand
- Short run vs. long run

THE BIG IDEA

Chapter 2 gave the DIRECTION of the response; this chapter measures its SIZE. How much quantity responds to a change in price is what almost every practical decision turns on.

3.1

Introduction

- Gasoline, cigarettes, and a streaming price hike
- Direction vs. size of the response
- Why size is what matters in practice

3.1 INTRODUCTION

Three questions, one underlying issue



Gasoline

When the price rises 50 cents a gallon, do drivers cut back sharply, or hardly at all?



Cigarettes

Why can a tax on cigarettes raise large sums, but a similar tax on a luxury cruise raise far less?



Streaming

If a service raises its monthly price by \$2, will it collect more revenue or less?

WHAT THEY SHARE

Each is really the same question: how much does the quantity people buy respond to a change in price? Economists answer it with a number called elasticity.

3.2

Price Elasticity of Demand

- Measuring responsiveness
- The midpoint method
- Elastic, inelastic, unit elastic
- What makes demand elastic

3.2.1 MEASURING RESPONSIVENESS

What price elasticity of demand measures

■ Price elasticity of demand

The percentage change in quantity demanded divided by the percentage change in price. It measures how much quantity demanded responds to a change in price.

THE FORMULA

$$\varepsilon = (\% \text{ change in quantity demanded}) \div (\% \text{ change in price}).$$

Because a higher price lowers quantity, the ratio is always negative, by convention we drop the minus sign and report its size (absolute value). A larger number means more responsive, or more elastic, demand.

3.2.1 MEASURING RESPONSIVENESS

The midpoint method, worked on gasoline

- Price rises from \$3.00 to \$3.60; quantity falls from 100,000 to 96,000 gallons/week.
- Divide each change by the AVERAGE of start and end, so the answer is the same whether price rises or falls.
- Price: +\$0.60 on an average of \$3.30 $\approx 18\%$.
- Quantity: -4,000 on an average of 98,000 $\approx 4\%$.

$$\approx 0.22$$

$$\varepsilon = 4 \div 18$$

WHAT IT TELLS US

Gasoline buyers barely cut back: a large price increase brings only a small drop in quantity. Demand is strongly inelastic.

3.2.2 ELASTIC, INELASTIC, UNIT ELASTIC

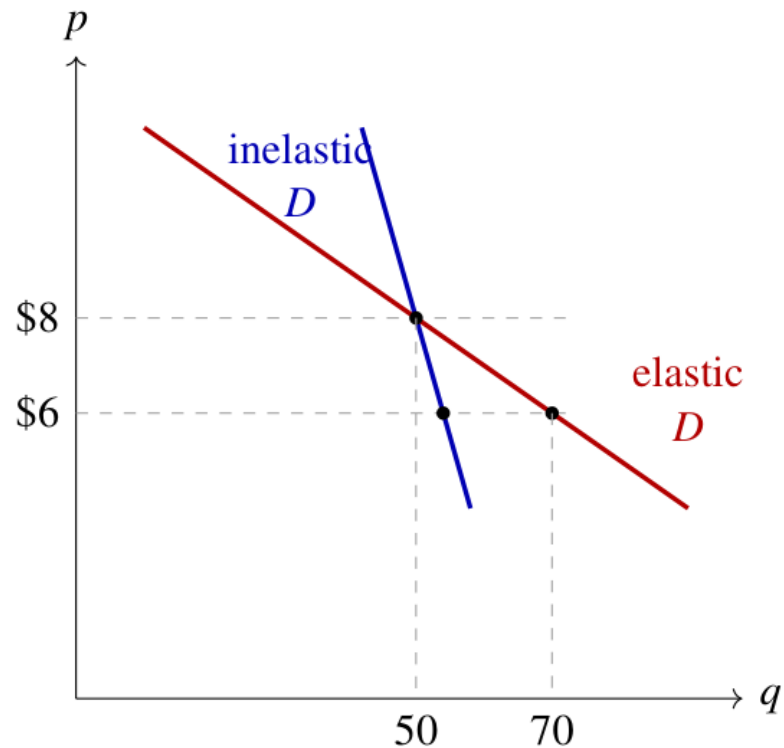
The value of ϵ sorts goods into three cases

Elasticity	Name	Meaning
Greater than 1	Elastic	Quantity responds MORE than price
Less than 1	Inelastic	Quantity responds LESS than price
Equal to 1	Unit elastic	Quantity responds in equal proportion

Table 3.1 Three cases of price elasticity of demand.

3.2.2 ELASTIC, INELASTIC, UNIT ELASTIC

Steep curves are inelastic, flat curves elastic



- Gasoline, at 0.22, is strongly inelastic, a steep curve.
- A single brand of bottled water beside a dozen rivals is highly elastic, a small price rise sends nearly all buyers away.

Figure 3.1 The same price fall causes a small quantity change along an inelastic (steep) curve and a large one along an elastic (flat) curve.

3.2.3 WHAT DETERMINES ELASTICITY?

Four forces make demand more elastic (1–2)

■ 1. Close substitutes

The more easily buyers can switch to another good, the more elastic demand is. Demand for one brand of cola is far more elastic than demand for cola as a whole.

■ 2. Necessities versus luxuries

Necessities (insulin, electricity) have inelastic demand; luxuries (cruises, second homes) have elastic demand, since buyers can more easily do without them.

3.2.3 WHAT DETERMINES ELASTICITY?

Four forces make demand more elastic (3–4)

■ 3. Share of the budget

A good that takes a large share of spending (rent) has more elastic demand than one that takes a tiny share (salt), because buyers watch its price more closely.

■ 4. Time horizon

Demand is more elastic over longer periods. When gas prices rise, drivers can do little this week, but over years they buy efficient cars, move closer to work, or switch to transit.

3.2.4 A GALLERY OF REAL-WORLD ELASTICITIES

Representative estimates, inelastic to elastic

Good	Approx. ϵ of demand
Salt	0.1
Eggs	0.1
Gasoline (short run)	0.25
Coffee	0.3
Cigarettes	0.4
Gasoline (long run)	0.6
Automobiles	1.2
Restaurant meals	2.3
Foreign air travel	4.0

Table 3.2 Representative estimates of price elasticity of demand.

READING THE TABLE

Read top to bottom and the four determinants come to life.

Salt and eggs: cheap necessities, no close substitutes, tiny budget share, quantity barely responds.

Automobiles, meals, foreign travel: costly luxuries with many substitutes, buyers respond sharply.

3.3

Elasticity and Total Revenue

- The total-revenue rule
- Revenue along a linear demand curve
- Should the firm raise its price?

3.3 ELASTICITY AND TOTAL REVENUE

Revenue rises, peaks, then falls

Price	Quantity	Total revenue	Demand is
\$9	2	\$18	elastic
\$8	4	\$32	elastic
\$7	6	\$42	elastic
\$6	8	\$48	elastic
\$5	10	\$50	unit elastic
\$4	12	\$48	inelastic
\$3	14	\$42	inelastic
\$2	16	\$32	inelastic
\$1	18	\$18	inelastic

Table 3.3 Total revenue along a straight-line demand curve.

FOLLOWING THE COLUMN

Raising price from \$1 toward \$5, revenue climbs \$18 → \$50: in the INELASTIC range the higher price exceeds the few lost sales.

Beyond \$5, revenue falls: in the ELASTIC range lost sales win.

Revenue peaks at \$5, where demand is unit elastic.

3.3 ELASTICITY AND TOTAL REVENUE

The rule every manager should know

THE TOTAL-REVENUE RULE

When demand is INELASTIC, raising the price raises total revenue. When demand is ELASTIC, raising the price lowers total revenue.



Inelastic demand

A streaming service with loyal subscribers can raise its price and collect more.

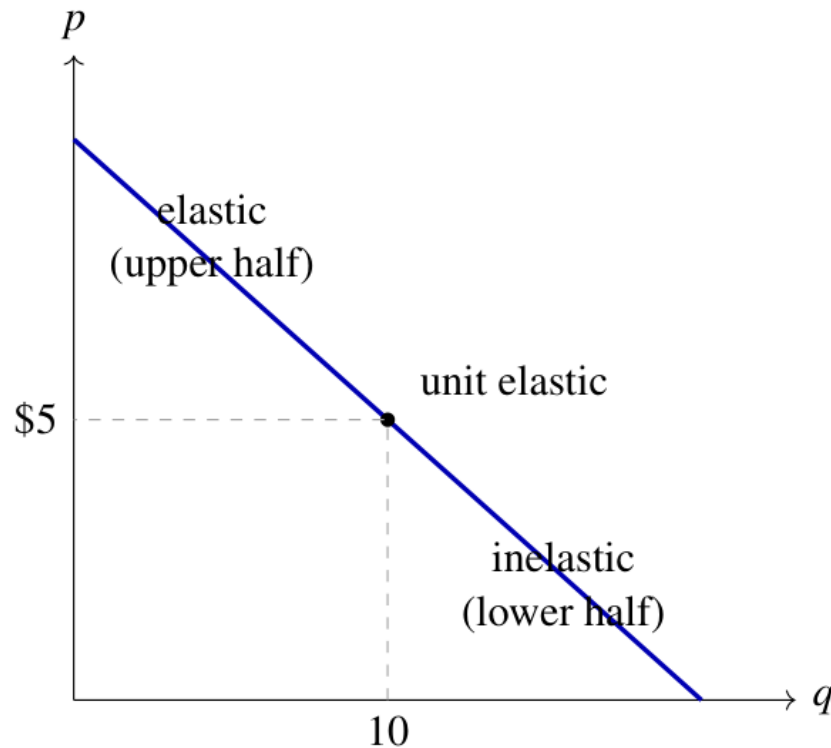


Elastic demand

A roadside fruit stand facing a dozen rivals would only drive customers away.

3.3 ELASTICITY AND TOTAL REVENUE

Elastic above the midpoint, inelastic below



- Upper portion of the curve (above the midpoint): elastic.
- Lower portion (below the midpoint): inelastic.
- Total revenue is largest right at the midpoint.

Figure 3.2 Demand is elastic above the midpoint and inelastic below it; total revenue is largest at the midpoint.

3.3.1 A WORKED EXAMPLE

Should the streaming firm raise its price?

THE SETUP

A service charges \$10/month to 200,000 subscribers and considers \$12. The price rise is about 18% by the midpoint method. The answer depends entirely on elasticity.



Inelastic, $\epsilon = 0.5$

- Subscribers fall ~9% → 183,000
- Revenue \$2.0M → ~\$2.20M
- RAISE the price



Elastic, $\epsilon = 2.0$

- Subscribers fall ~36% → 138,000
- Revenue → ~\$1.66M (falls)
- Do NOT raise; maybe lower it

3.3.1 A WORKED EXAMPLE

Self-check: is the latte elastic or inelastic?

SELF-CHECK

A coffee shop raises a latte from \$5 to \$6, and daily sales fall from 100 to 80. Using the midpoint method, is demand elastic or inelastic?

Price: +\$1 on an average of \$5.50 $\approx 18\%$. Quantity: -20 on an average of 90 $\approx 22\%$.

$\epsilon \approx 22 \div 18 \approx 1.2$, greater than 1, so demand is ELASTIC.

3.4

Income and Cross-Price Elasticity

- Income elasticity: normal vs. inferior
- Necessities, luxuries, and Engel's law
- Cross-price elasticity: substitutes vs. complements

Income elasticity of demand

■ Income elasticity of demand

How quantity responds to a change in buyers' income. Positive for normal goods (higher income raises demand), negative for inferior goods (higher income lowers it).



Necessities

Normal goods with income elasticity between 0 and 1, demand grows slower than income.



Luxuries

Income elasticity above 1, demand grows faster than income (restaurant meals, air travel).

Engel's law: as countries grow richer, spending on luxuries rises faster than income, spending on staples slower, first noted in the nineteenth century.

Cross-price elasticity of demand

■ Cross-price elasticity of demand

How the quantity of one good responds to a change in the price of another. The sign alone tells a firm whether another product is its rival or its partner.



Substitutes (+)

A higher price for tea raises the demand for coffee, positive cross-price elasticity.



Complements (−)

A higher price for game consoles lowers demand for the games, negative cross-price elasticity.

Sorting goods by income elasticity

Category	Income elasticity	Examples
Necessities	small positive (~0.2–0.5)	bread, electricity
Luxuries	above 1	restaurant meals, vacations, jewelry
Inferior goods	negative	intercity bus travel, store-brand noodles

Income elasticity: luxuries boom in good times and slump in recessions.

3.4.1 INCOME AND CROSS-PRICE IN PRACTICE

The sign reveals the relationship

Pair	Relationship	Cross-price elasticity
Butter and margarine	substitutes	positive (+)
Cars and gasoline	complements	negative (−)

Firms watch these signs: they reveal whether a product is a rival or a partner.

3.5

Price Elasticity of Supply

- How readily sellers change output
- Time, spare capacity, storage
- Corrective (sin) taxes and elasticity

3.5 PRICE ELASTICITY OF SUPPLY

Supply has an elasticity too

■ Price elasticity of supply

How much the quantity supplied responds to a change in price, again a ratio of percentage changes. Its main determinant is how easily sellers can change output.



Inelastic supply

A parking lot near a stadium: however high the price on game day, the number of spaces is fixed.

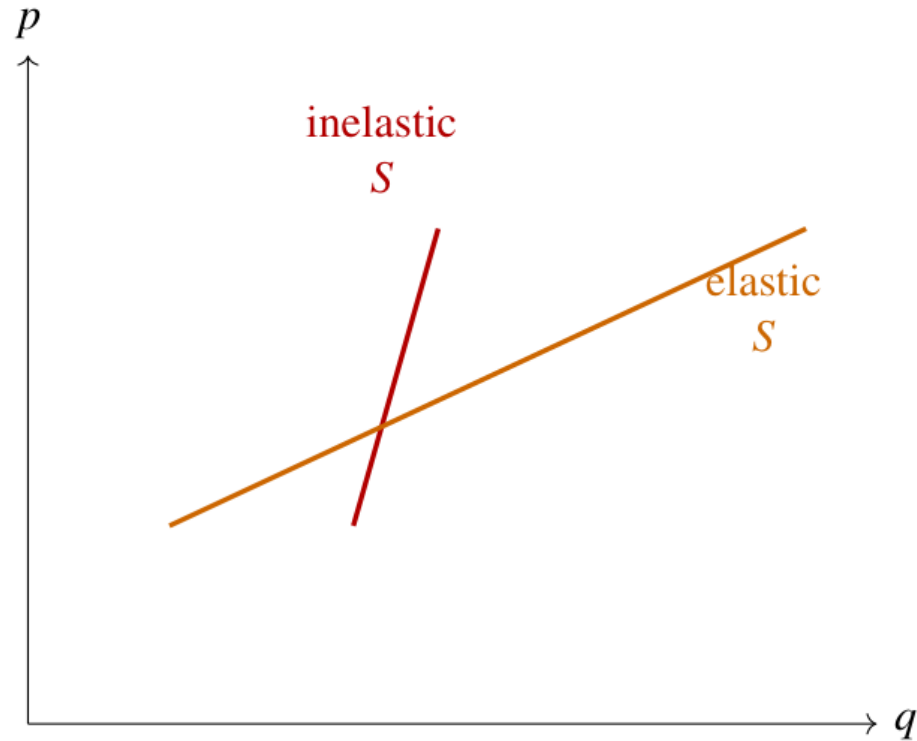


Elastic supply

Manufactured goods with spare factory capacity: firms can quickly produce more.

3.5 PRICE ELASTICITY OF SUPPLY

Steep supply is inelastic, flat is elastic



- As with demand, supply is more elastic over longer horizons.
- Given enough time, firms can build new capacity and bring more to market.

Figure 3.3 A steep supply curve is inelastic; a flat one is elastic.

3.5.1 WHAT DETERMINES SUPPLY ELASTICITY?

Three factors determine supply elasticity

1

1. Time horizon

Given time, firms hire, build plants, plant fields, supply is almost always more elastic in the long run.

2

2. Spare capacity

A factory below its limit can raise output quickly and cheaply; one at full capacity cannot.

3

3. Ability to store

Storable goods can be released when prices rise; fresh fish, hotel rooms, electricity cannot, very inelastic.

Why a sin tax's effect depends on elasticity

■ Corrective taxes (sin taxes)

Taxes meant to discourage harmful consumption. What such a tax accomplishes depends on the elasticity of demand for the good.



Inelastic good

Cigarettes: a tax changes behavior only modestly but raises a great deal of revenue, people keep buying.



Elastic good

Sugary drinks: a tax produces a larger fall in consumption, the very goal of a health-motivated tax.

3.5.2 CORRECTIVE TAXES AND ELASTICITY

The same tax, two very different effects

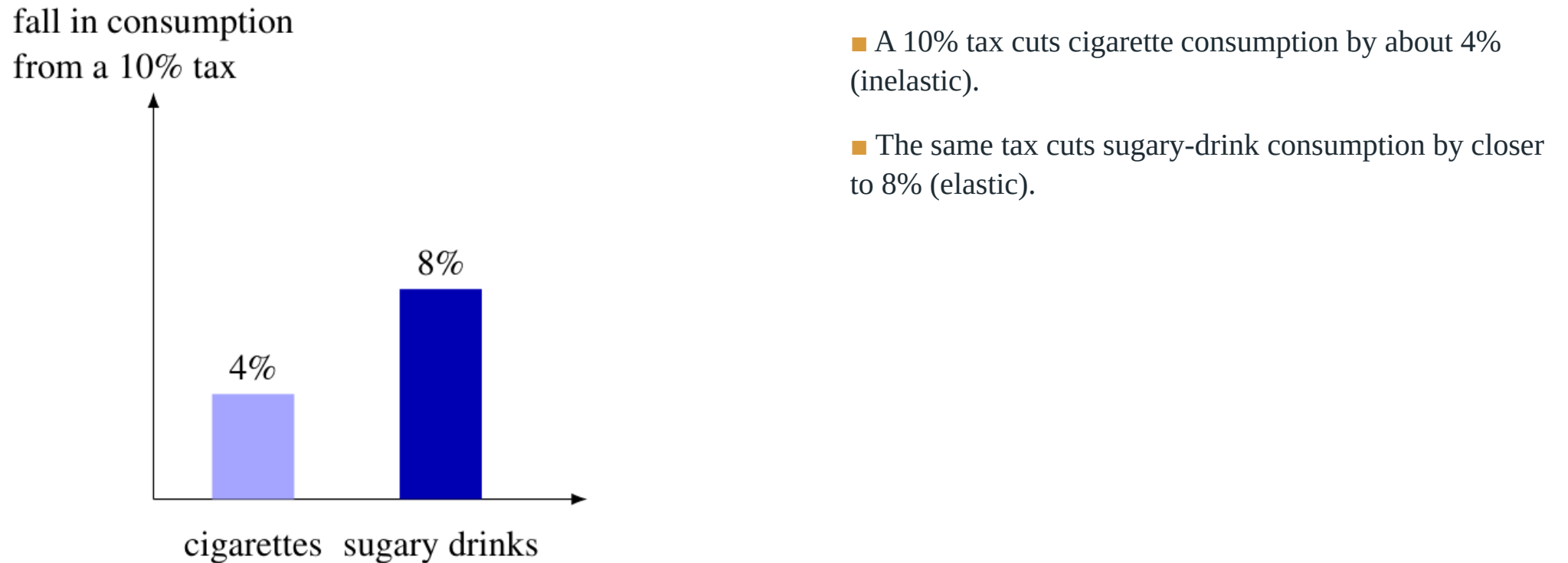


Figure 3.4 The same tax cuts consumption far more for an elastic good (sugary drinks) than for an inelastic one (cigarettes).

3.5.2 CORRECTIVE TAXES AND ELASTICITY

Sugar taxes in practice



UK, 2018

The Soft Drinks Industry Levy rose with sugar content. Facing price-sensitive buyers, many makers reformulated to less sugar to escape the tax.



Mexico, 2014

A 1-peso/liter tax on sugary drinks (~10% price rise). Colchero et al. (2017): purchases fell ~5.5% in year one, ~10% in year two, average ~7.6%, largest drops among the poorest.

To predict what a tax will do, raise revenue, change behavior, or both, a regulator must first know the elasticity of demand. (Explore it online: tax slider in the supply-and-demand tool.)

3.6

Case Study: Why Cigarette Taxes Reduce Smoking Only So Much

One inelastic number explains both revenue and limits.

3.6 CASE STUDY

Inelastic demand: revenue yes, behavior only so much

≈ 0.4

adult cigarette price elasticity (Chaloupka & Warner, 2000)

-4%

quantity smoked per +10% price

- Because demand is inelastic, quantity falls proportionally less than price rises.
- From the total-revenue rule: a tax raises total spending on cigarettes, and so raises tax revenue.
- The same inelasticity that makes cigarettes a reliable revenue source also limits how much a tax can cut smoking.

3.6 CASE STUDY

One group for whom the tax works better

YOUTH DEMAND IS ELASTIC

Young people are roughly twice as responsive to price as adults, a 10% price increase is estimated to lower youth smoking by roughly 7 to 10%.

- Teenagers have lower incomes, are less addicted, and are more swayed by price.
- This is why public-health economists favor large tobacco taxes specifically to keep young people from starting, the population whose demand is elastic enough for the tax to make a real difference.

3.7

Empirical Evidence: How Elastic Is the Demand for Gasoline?

The time-horizon effect, made concrete.

3.7 EMPIRICAL EVIDENCE

Espey (1998): a deep meta-analysis

- Pooled more than 300 short-run and 250 long-run estimates from studies spanning 1966–1997.
- Short run: drivers are locked into the cars they own and the distances they commute.
- Long run: they buy efficient cars, change where they live and work, shift to transit.

0.23–0.26

median short-run ε

≈ 0.58

long-run ε

THE LESSON

The long-run response is more than twice as large, yet still below 1. Gasoline is inelastic over any horizon, which is why fuel taxes raise revenue and oil shocks pass so painfully to budgets.

CHAPTER 3

Key takeaways

1

Elasticity

$\varepsilon = \% \Delta Q \div \% \Delta P$, reported as an absolute value via the midpoint method.

2

Three cases

$\varepsilon > 1$ elastic, $\varepsilon < 1$ inelastic, $\varepsilon = 1$ unit elastic; driven by substitutes, luxury, budget share, time.

3

Total-revenue rule

Inelastic: raising price raises revenue. Elastic: raising price lowers it. Revenue peaks at unit elasticity.

4

Income & cross-price

Income ε signs normal vs. inferior; cross-price ε signs substitutes vs. complements.

5

Supply elasticity

Determined by time horizon, spare capacity, and storability.

6

Evidence

Cigarette taxes ($\varepsilon \approx 0.4$), gasoline short vs. long run (0.25 vs. 0.58), and sugar taxes.