Basic Monopoly Theory

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Lecture 9
Turbo Section
Elements of Economic Analysis II
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Introduction

Competitive model so far assumes *price-taking*:

1. If firm charged even little above "market price", *no demand*
2. If firm increases production *no fall in price*

Never literally satisfied and bad approximation in detail

$\Longrightarrow$ Today we'll begin to study incentives to move prices

1. Incentive to reduce quantity
2. The Lerner elasticity pricing rule
   - Basic principles of trade-off
   - Ironing, learning and uncertainty
3. Deadweight loss and measurement
   - Quantifying the inefficiency created by monopoly
   - How big are the economic losses from monopoly in practice?
4. Tax pass-through in monopoly
5. Tax pass-through and other comparative statics
6. What do real residual demand curves look like?

Quantity reduction and marginal revenue

Basic idea: monopolies reduce quantity to raise price

- To sell more, price must fall on all *infra-marginal* units

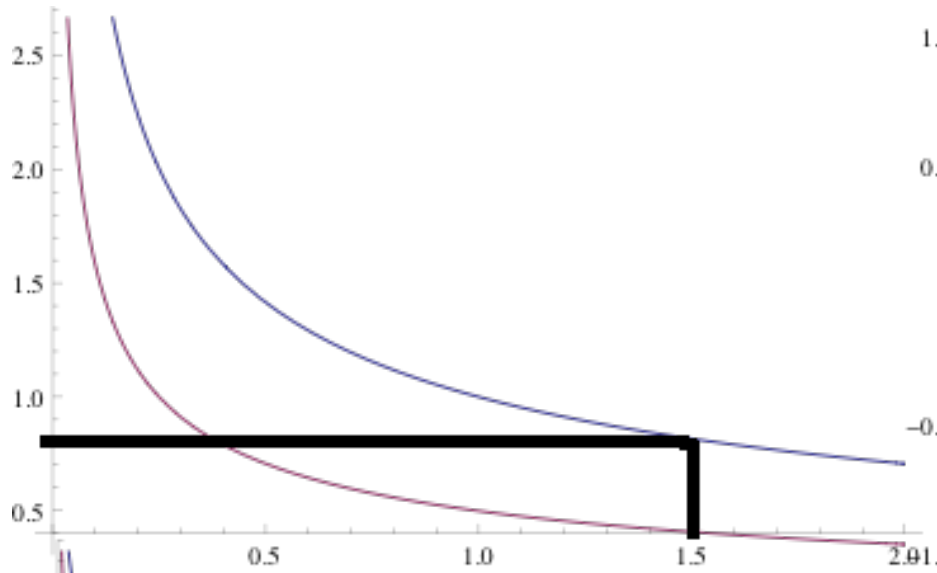
$\Longrightarrow$ Trade-off between selling more and higher price

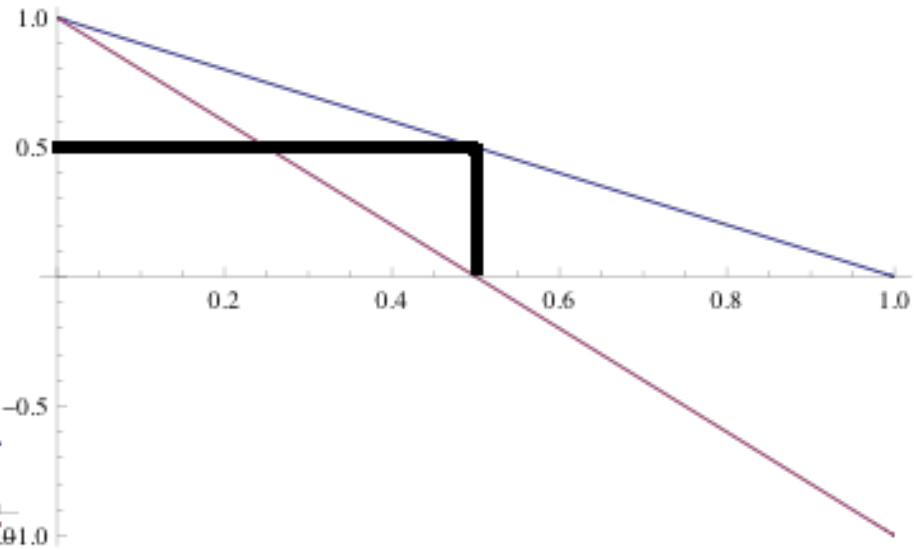
- Maximize $\pi(q) = P(q)q - C(q)$; but don't set $P = MC$
- Instead set $MR = MC$: MR formula?

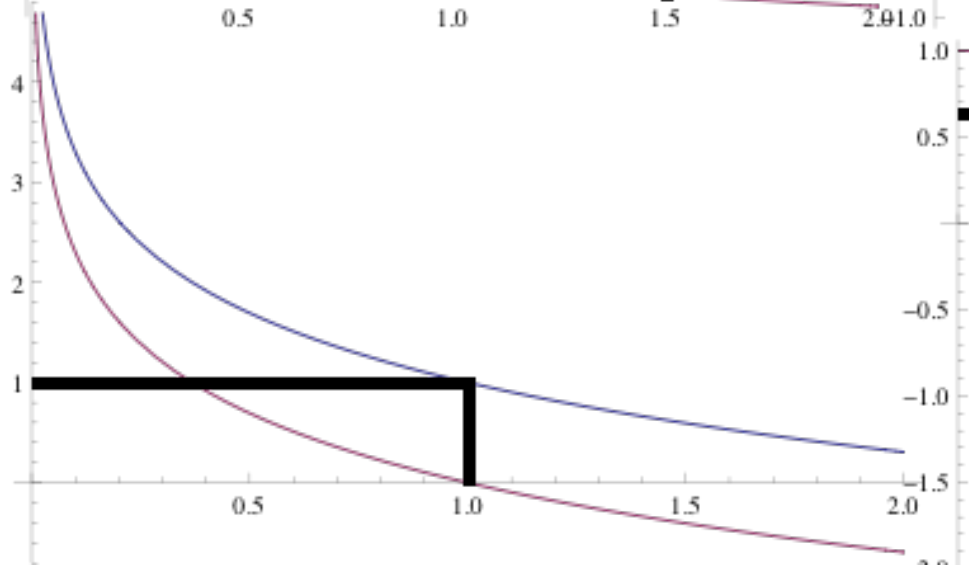
$$MR(q) = \underbrace{P(q)}_{\text{good, competitive}} + \underbrace{P'(q)q}_{\text{market power/Cournot distortion}}$$

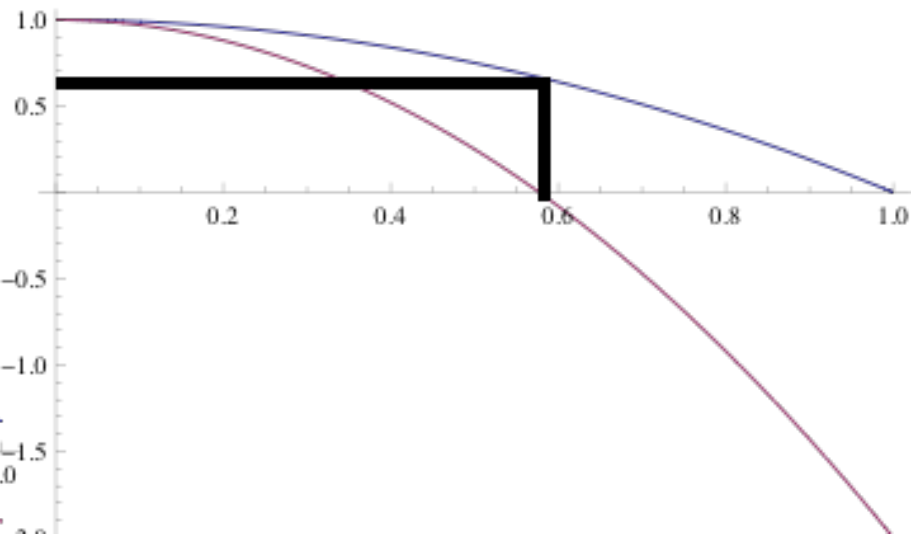
- Distortion is proportional to:
  1. The number of units you sell
     - If you are small part of industry, small impact
  2. The amount you move the price
     - If your impact on price is small, distortion small

Graphical examples of marginal revenue









When does monopoly apply?

Monopoly sounds like "this is the only company"

- But basic mechanism applies to *any non-price-taker*
  - Includes when company *can affect purchase price*
- More or less severe depending on size of distortion
- So when do we use monopoly v. oligopoly?
  1. Monopoly focuses on *direct effects of interventions*
     - Effects through changes in other eq. behavior ignored
     - Monopoly takes these as fixed, changes small
  2. Monopoly ignores welfare effects on other firms
     - Value to them ignored or pecuniary
     - Cannot be used to think about cross-firm externalities
  3. Monopoly model cannot study changes in structure
     - Useless for topics like merger analysis, effect of competition

$\Longrightarrow$ Focus on incentives of one firm, input to other analysis

Lerner's mark-up pricing rule

Let's derive Lerner pricing?

$$P'q = \frac{dP}{dq}q = \frac{q}{\frac{dQ}{dp}} = \frac{p}{\frac{dQ}{dp}\frac{p}{q}} = -\frac{p}{\epsilon}$$

$$\Longrightarrow \; MR(q) = \left(1 - \frac{1}{\epsilon}\right) p = MC(q) \; \Longrightarrow$$

Lerner's elasticity pricing rule

$\frac{p-c}{p} = \frac{1}{\epsilon}$, *measures market power*

Note that:

1. Monopolist will never produce where $\epsilon < 1$
   $\Longrightarrow$ $MR < 0$, always reduce quantity
2. Only works for positive prices: credit cards negative!

Ironing, uncertainty and learning about demand

Simple story, but applies even with several wrinkles:

1. Weird marginal revenue curves and ironing
   - What if the MR curve doesn't slope down (relative to MC)?
   - Just like ironing *MC*: make relatively monotone
   - Skip over anti-monotone regions
2. What if demand is not known
   - We have assumed simple price-quantity relationship
   - When demand uncertain, choose both price an quantity
   - Still, Lerner rule based on costs and elasticity:
     - *Average quantity sold*, not average quantity produced
3. Learning about demand
   - To avoid this, choose right price, learn about demand
   - Try charging various prices, see what happens
   - Base price on past (or current!) experience

The monopoly wedge

Monopoly raises prices above costs; two effects:

1. *Transfers* wealth from consumer to monopoly
   - Distributive problems, but no net social loss
2. *Reduces quantity* of goods consumed
   - Some individuals would be willing to buy at cost
   - But don't because price is higher

$\Longrightarrow$ *Deadweight loss from monopoly*

   - Monopolist raises prices on all to charge *infra-marginal*
     - If could tell who is who, price discriminate, no distortion

$\Longrightarrow$ Consumer purchases create externality, firm profits

   - Could internalize in Pigouvian manner
   - In Lecture 13, we'll talk about problems
   - Could also mandate higher quantity, lower price
   - In Lecture 12 we'll talk about this possibility

The deadweight loss triangle

To measure these losses we consider standard welfare triangle

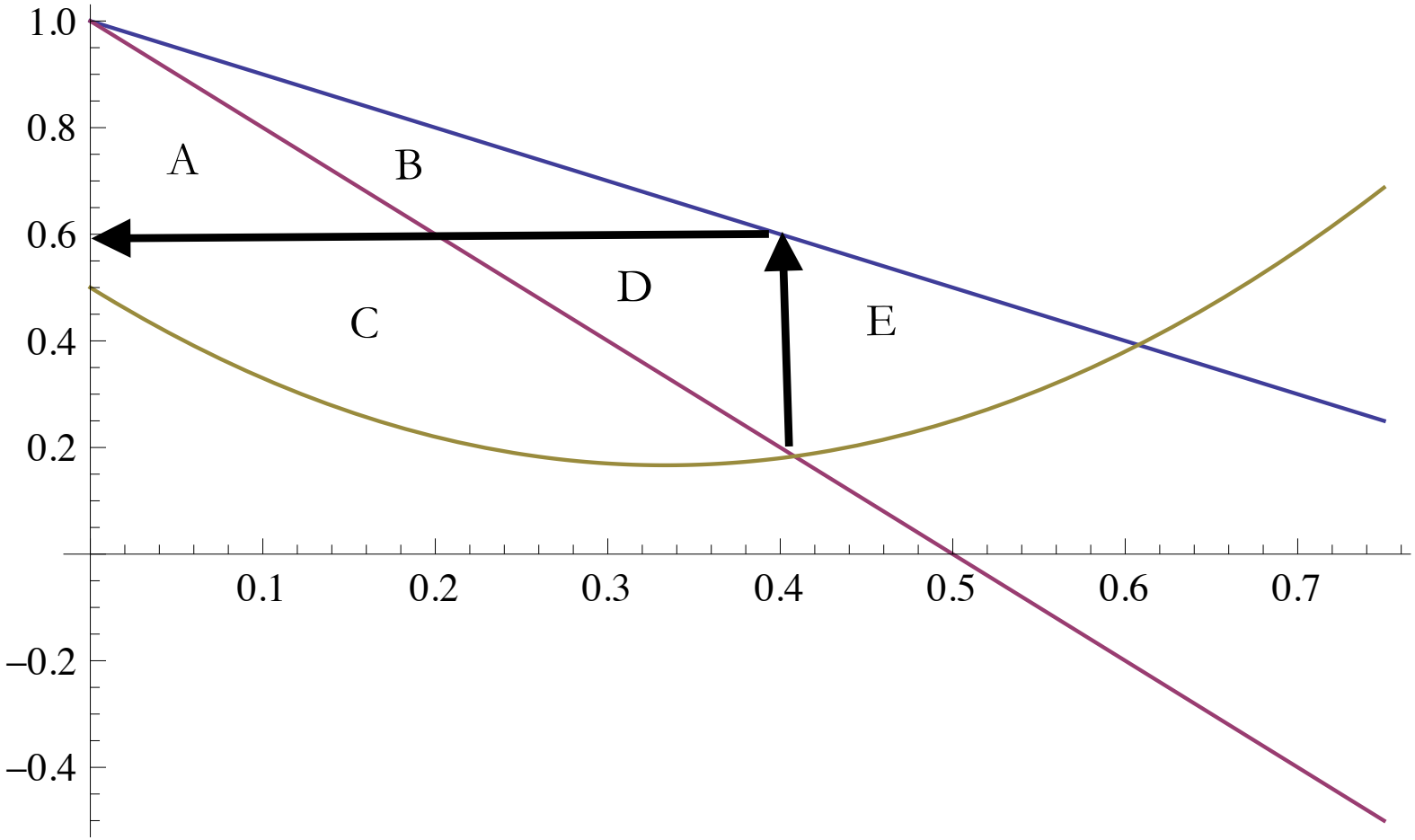
- Like distortions from tax: externality loss same as tax loss
- Only difference is size determined by monopoly's optimum

$\Longrightarrow$ Particular size, relationship to monopoly profits

  - We'll explore this in a bit

- Two different expressions, as usual:
  1. $\int_{q_M}^{q^\star} P(q) - MC(q)dq$
  2. $\int_{MC(q_M)}^{P(q_M)} \min\{S(p), D(p)\}\, dp$
- Similarly profits can be area above MC plus:
  1. Square of price above MC
  2. Or area between MR and MC
- Also CS is between P and MR, or above price

Graphical example of welfare quantities



Harberger's economy-wide exercise

1950's: Chicago's Arnold Harberger tried to measure, how?

1. Identified "abnormal profits" with monopoly
   - Assumes constant marginal cost/constant returns
2. Assume all industries have constant elasticity of 1
3. Assume resources allocated perfectly within industry
4. Got data on profitability of industries, compared
5. Backed out degree of excess profits

Found something very surprising; what?

- Total loss from monopoly very small!
- About $\frac{1}{10}$ of one percent of GDP!
- Basic reason: triangle proportional to square of distortion

$\Longrightarrow$ Lots of small distortions make little difference
- Requires a few big distortions to really matter

$\Longrightarrow$ Not everything that matters in theory matters in practice

Broader lessons from Harberger's work

Lots wrong with Harberger's work?

1. Monopoly arises particularly with increasing returns

   $\Longrightarrow$ Greatly understates degree of monopoly

2. Most of heterogeneity is *within industry*, not across
3. Elasticity of demand uncertain, heterogeneous

$\Longrightarrow$ Harberger big underestimate (order of magnitude or two)

- Still, carries some important lessons:
  1. Monopoly distortions exist, but not necessarily large
  2. Takes large price change before DWL significant
  3. Primary impact of monopoly may be transfer, not DWL
     - We'll return to this in Lecture 13
  4. Details (costs, heterogeneity) crucial for measurement

Pass-through under monopoly v. competition

Incidence of tax different with monopoly than competition

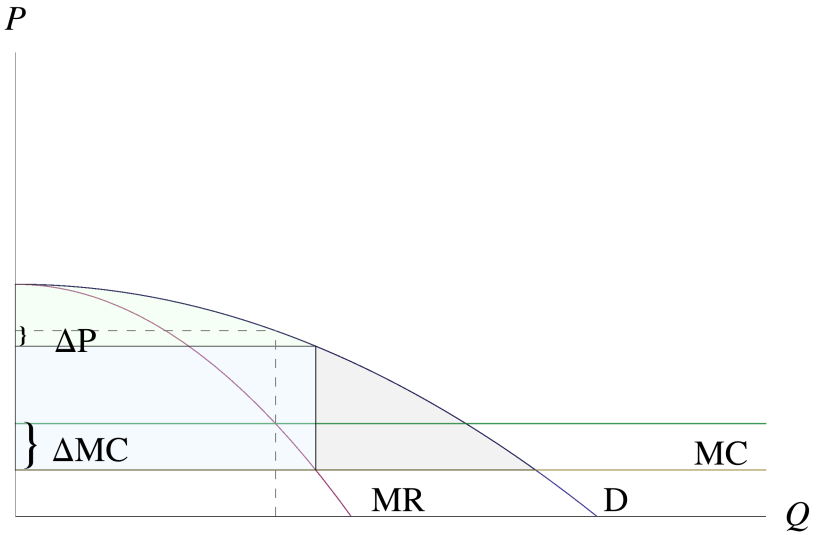
- Competition: $P = MC$ so $\rho_C \equiv \frac{dp}{dt} = \frac{P'}{P' - MC'}$ or $\frac{dp}{dt} = \frac{1}{1 + \frac{\epsilon_D}{\epsilon_S}}$
- Classical incidence formula
- Under monopoly $MR = MC$ so $\rho \equiv \frac{dp}{dt} = \frac{P'}{MR' - MC'}$ or

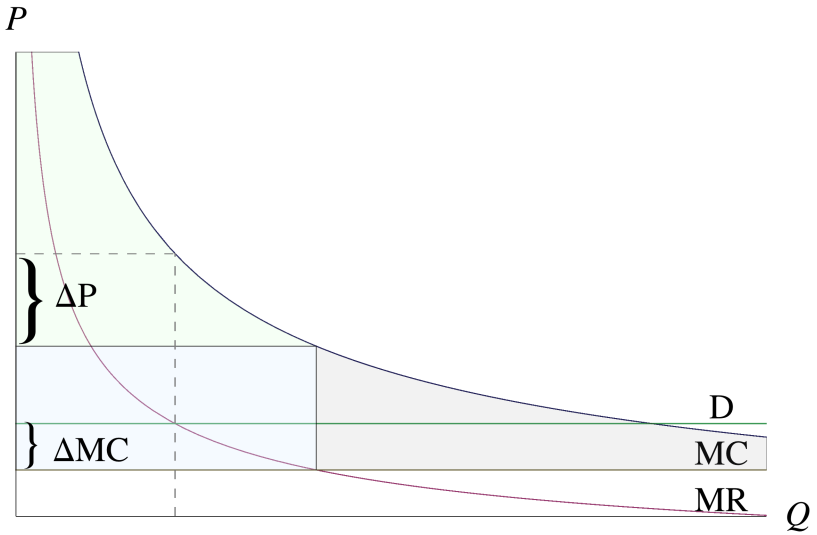
$$\rho = \frac{1}{1 + \frac{\epsilon_D}{\epsilon_S} + \frac{\bar{\epsilon}_D}{\epsilon_D} - \frac{1}{\epsilon_S} - \frac{1}{\epsilon_D}}$$

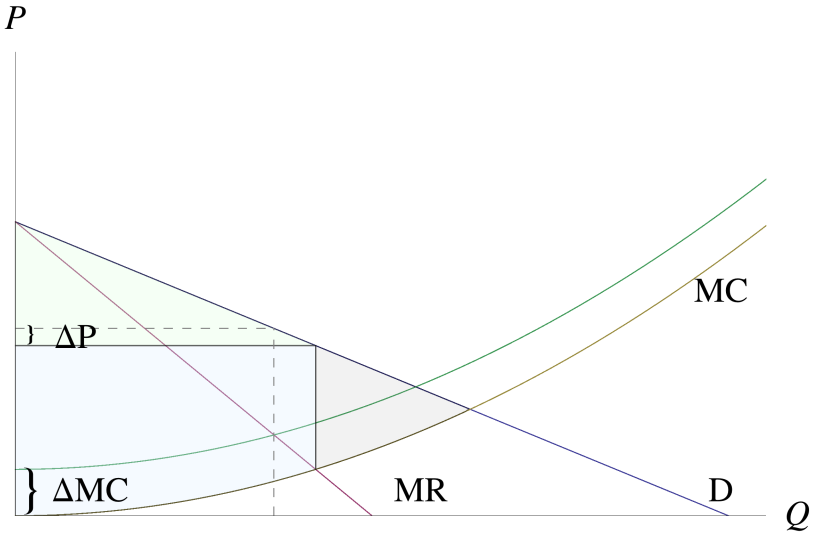
- Always positive (bottom is second-order condition)
- $\bar{\epsilon}_D \equiv \frac{d\epsilon_D}{dp} \frac{p}{\epsilon_D}$ is *super-elasticity*
  - Curvature of demand function; new element from monopoly
  - When demand v. elastic (almost competitive) doesn't matter
  - Large the more concave demand is; negative if very convex

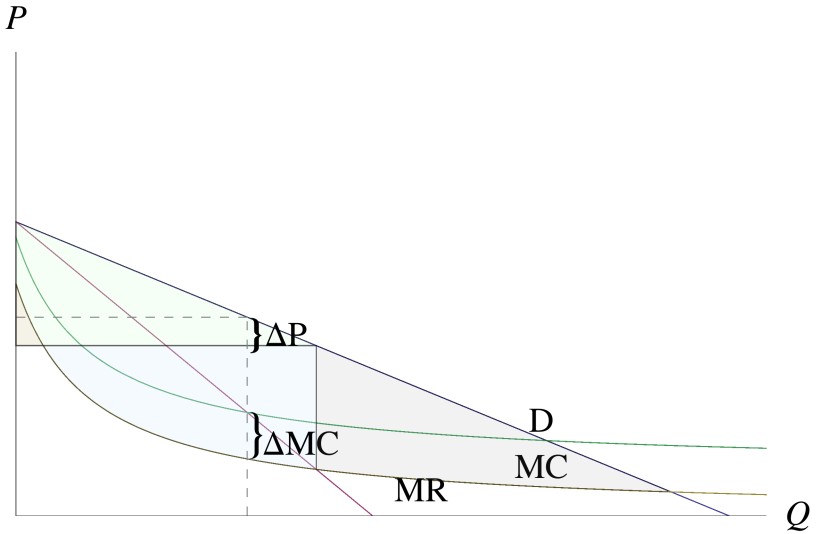
  $\Longrightarrow$ More convex demand has higher pass-through
    - If MR slopes up, may be infinite: ironing makes infinite
    - We'll see real-world example below; meantime made-up

Graphical representation of pass-through









Pass-through and consumer surplus

Raising taxes enough eliminates market

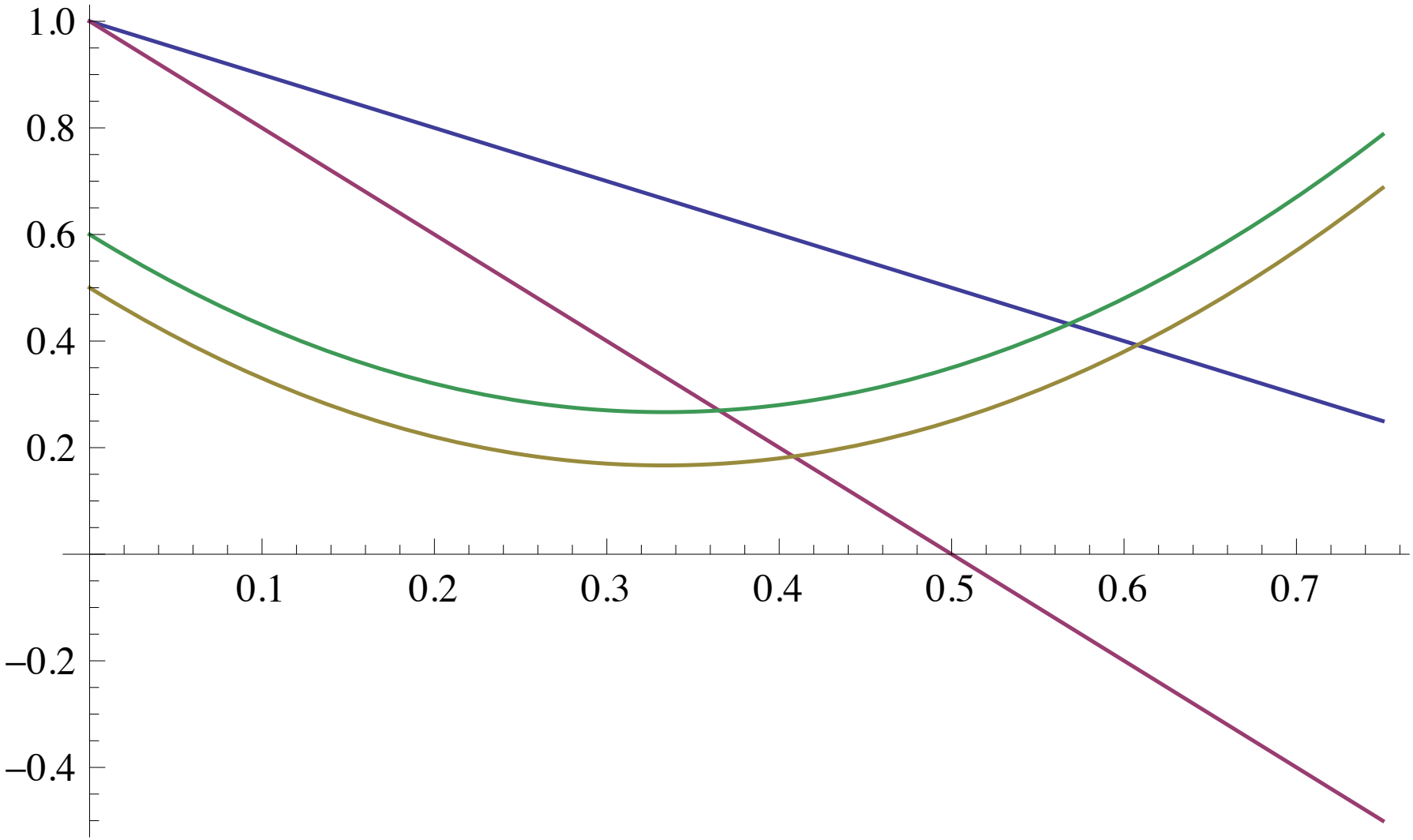
- Thus use pass-through to trace out surplus of market
- How much does raising taxes reduce profits?
  - Envelope theorem on price, just current quantity: $\frac{d\pi}{dt} = -q$
- How much does it reduce *CS*?
  - Consumer surplus formula: $\frac{dCS}{dt} = -q\frac{dp}{dt} = -q\rho$

$\Longrightarrow$ $\frac{CS}{\pi}$ = average pass-through rate

$$\frac{CS}{\pi} = \overline{\rho} \equiv \frac{\int_{t=0}^{\bar{t}} \rho q dt}{\int_{t=0}^{\bar{t}} q dt}$$

- Similar argument under competition
- Profits fall by $1 - \rho$, so $\frac{CS}{\pi} = \frac{\overline{\rho}}{1-\overline{\rho}}$
- More general ($\lambda = 1$ competition, 0 monopoly): $\frac{CS}{\pi} = \frac{\overline{\rho}}{1-\lambda\overline{\rho}}$

Graphical representation of pass-through and surplus



Pass-through and demand pass-through

Pass-through also determines response to demand?

- Imagine there is a subsidy s given to consumers
- Demand pass-through $\rho_d \equiv \frac{dP}{ds}$
- Consumer subsidy and producer tax of \$1 has no effect
  - If firm raises price \$1, everything exactly the same
  - Fundamental result on neutrality of physical incidence
    - General, applies with competition as well

$\Longrightarrow$ Quantity does not change, price rises by \$1

Theorem

$$\rho + \rho_d = 1$$

- $\rho > 0$, but may be > 1 so ρ_d may be negative
  - May seem counter-intuitive, but monopolist follows demand

Pass-through and quantity pass-through

Another natural question is how firm responds to competition

- Simple form, which we will study later, is another producing
- Suppose firm has constant marginal cost c
- Another firm, with same cost, produces $\tilde{q}$
- *Quantity PT*: how much total $q^\star$ increases, $\rho_q \equiv \frac{dq^\star}{d\tilde{q}}$
- This is actually closely connected to pass-through
- Profits are now $[P(q) - c](q - \tilde{q})$
- So FOC is $P'(q)(q - \tilde{q}) + P(q) = c$
  - $\tilde{q}$ serves to reduce inframarginal units, incentive to distort
  - This is competition at work
- Size of effect proportional to P', equivalent to subsidy of P'
- Thus changes price by $P'\rho$ and quantity by $Q'P'\rho$
  - But by inverse function theorem, $Q'P' = 1$...

$\Longrightarrow$ $\rho_q = \rho$ (with constant MC, similar in general)

Quantity pass-through and deadweight loss

We can use this concept to link to deadweight loss

- When $\tilde{q}$ increases, how much do profits fall?
  - Firm loses $\tilde{q}$ sales worth $M \equiv P - c$ each
  - By envelope theorem, therefore, $\frac{d\pi}{d\tilde{q}} = -M$
- When $\tilde{q}$ increases, how much does DWL fall?
  - Effectively externality of size M
  - So increasing production raises social welfare by Mdq
  - Production rises by $\rho_q = \rho$ so $\frac{dDWL}{dq} = -M\rho$

$\Longrightarrow$ With CMC, $\frac{DWL}{\pi} = \tilde{\rho} = \frac{\int_{\tilde{q}=0}^{\tilde{q}=q^\star} \rho M d\tilde{q}}{\int_{\tilde{q}=0}^{\tilde{q}=q^\star} M d\tilde{q}}$

- Thus pass-through also determines size of DWL
  - To calibrate, we need to figure out what ρ is in real world
  - Simple way to do this is move prices around, see quantities

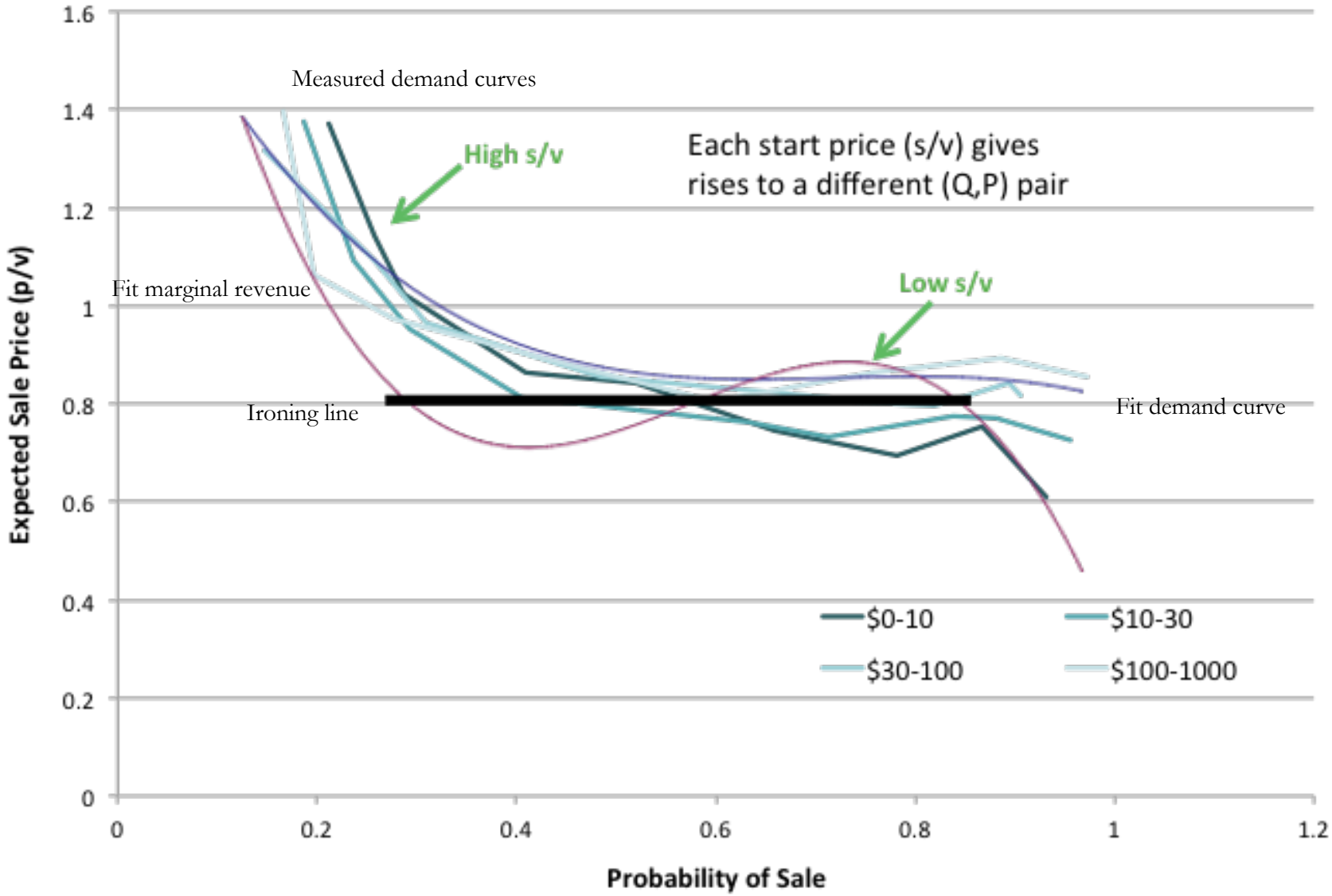
Einav et al. (2011) analysis of seller experiments

One place where this is very easy to do is internet

- Einav et al. collect data from seller experiments on EBay
  - Many seller try identical items at different prices
  - Trying to figure out what price to charge, terms to use
  - Just like they should do to learn
- Use to construct "demand curve" in auctions?
  - Higher reserve price set $\Longrightarrow$ higher price if sale
    - If higher than bid of second highest, raises price
  - Also reduces probability of sale
    - If no one bids above, no sale occurs

  $\Longrightarrow$ Just like a demand curve
    - Draw out average price, probability of sale relationship
    - Marginal cost always constant (probability of sale)
  - Basic shape very similar across products

Einav et al. data



Other evidence on pass-through

Here, pass-through infinite over ironing region!

$\Longrightarrow$ At least in some cases, PT very large

- General other evidence fairly poor
- One source income: suppose WTP proportional
- Then with power law, demand has constant elasticity, PT>1
  - Luxuies likely even more spaced-apart, superior goods

  $\Longrightarrow$ Luxury goods likely have very high pass-through
- Others (inferior, money saving) have low pass-through
  - Construction materials, office supplies; homogeneous WTP
- Evidence shows range of PT, but corresponds to theory
  1. When very elastic, cost structure crucial:
     - Economies or diseconomies of scale
  2. When less elastic (strong monopoly), distribution of WTP
     - Judge by how much CS in market