Industrial Organisation

Lecture 1: Introduction to IO

Tom Holden

http://io.tholden.org/

Key info: Contact details

- Email: t.holden@surrey.ac.uk

- Standard office hours:
  - Thursday, 12-1PM + 3-4PM, 29AD00

- However, during term:
  - **CLASSES** will be run in the first hour.
  - Thursday, 12-1, in room 40AD00
  - If anyone turns up.

- For private problems:
  - Come to my office between 3-4PM.
  - Ideally, e-mail first so I know to wait for you.
  - Other times are possible by e-mail appointment.

Key info: Web presence

- Course website is: http://io.tholden.org/
  - Going to SurreyLearn will just send you to this site.
- Has the last two years slides up already.
  - This year will have almost identical content to last year, so feel free to read ahead.
- Please use the comment facility on the site to ask about things you don't understand.
- This year, I will be videoing all lectures, and placing them on YouTube.

Key info: Readings

- Main text:
  - Oz Shy: "Industrial organization: Theory and applications" 338.6 SHY
    - "Goldilocks" level difficulty (I hope).

- Alternative texts:
  - Jean Tirole, "The Theory of Industrial Organization" 338.6 TIR
    - A little difficult in places.
  - Jeffrey Church and Roger Ware, "Industrial Organisation: A strategic Approach"
    - Not quite right for our course, but it is available for free at: http://is.gd/XHBLz4

- Plus, as ever, Google & Wikipedia are your friends.

Key info: Exams & timetable

- Midterm test (10%):
  - Very short answer section. One hour.
  - Week 6. Will provide mock.
- End of term test (20%):
  - Longer maths questions. Up to two hours.
  - Week 10. Again, there'll be a mock.
- Final exam (70%):
  - Very short answer section.
  - Rest is multi-part questions requiring both maths and discussion.
  - Again, there'll be a mock…

Key info: Practice questions

- Oz Shy's book contains exercises.
  - Do them!
  - The answers are online at: http://ozshy.50webs.com/bkman24.pdf
- He has additional problems online at: http://ozshy.50webs.com/io-exercises.pdf
  - With solutions at http://links.ozshy.com/io-solutions
- I'll set a few other questions.

Outline

- What is IO?
  - Aim of the course
- Some “revision”:
  - Demand curves
  - Consumer surplus
  - Cost functions
  - Profits
  - Welfare
  - Monopoly
- Note: There will be a lot of work on the board today.
  - It is important everyone get these basic bits of maths.
  - If you missed this lecture, ask a friend for notes, and study the readings.

What is IO?

- IO *is not* the economics of manufacturing industries (as opposed to agriculture etc.).

- IO *is* the economics of:
  - the firm and its behaviour,
  - the structure of markets,
  - the regulation of markets.

- IO is the field of most economic consultants.

Topics within IO

- Firm's decisions:
  - Entry, exit, mergers
  - R&D
  - Advertising
  - Capital investment
  - Pricing

- Market structure:
  - How do firms interact?
  - Why are some firms large?
  - Why are some industries highly concentrated?

- Competition policy:
  - Cartels and collusion
  - When should we regulate firms?

Aim of the course

- IO is a big subject.
- Our aim will be cover enough theory that you could go on to think independently about practical questions.
- The theory is fun on its own though.
  - It’s basically applied game theory.

Demand curves (1/2) (OZ 3.2)

- Two ways of thinking about aggregate demand curves.
  - Homogeneous consumers, wanting multiple units.
  - Heterogeneous consumers, wanting one unit each.
  - Can you explain graphically how they emerge?

- We will usually denote demand curves by $Q(p)$.
  - And inverse demand curves by $p(Q)$.
  - Given $Q(p)$ how do you derive $p(Q)$?

Demand curves (2/2)

- Two families of demand curves we will use a lot.
  - Linear: $Q(p) = q_0 - q_1 p$ or $p(Q) = p_0 - p_1 Q$.
  - Iso-elastic (aka constant-elastic): $Q(p) = cp^{-\alpha}$ or $p(Q) = kQ^{-\beta}$.

- How do we map from the parameters of the linear demand curve to the parameters of the linear inverse demand curve?
  - How do we go the other way?
  - How do we do the same for iso-elastic demand?

Elasticity of demand

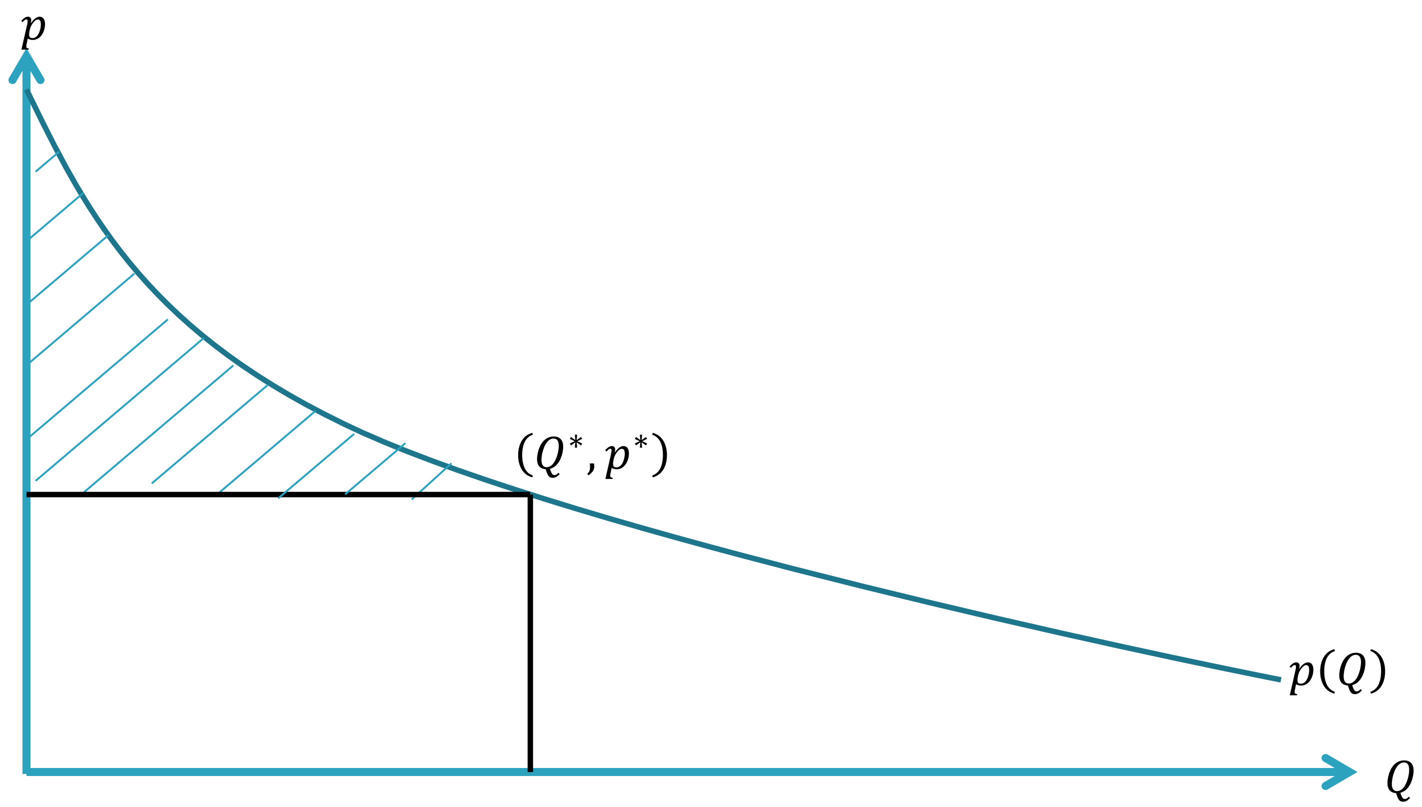
- The elasticity of demand at a quantity level Q is defined by: $\eta_p(Q) := \frac{\partial Q(p)}{\partial p}\frac{p}{Q}$.
- How do we find the elasticity of demand when we only have the inverse demand curve?
    - Hint: The Inverse Function Theorem states that: $\frac{df^{-1}(x)}{dx} = \left[\frac{df(x)}{dx}\right]^{-1}$.
- Demand is elastic when $|\eta_p(Q)| > 1$.
- Demand is inelastic when $|\eta_p(Q)| < 1$.
- When is linear demand elastic?
- What is the elasticity of an iso-elastic demand curve?

Consumer surplus (1/3) (OZ 3.3 has a special case)

- A consumer has utility $U(Q) = v(Q) + M$, where:
  - Q is the quantity of some good,
  - M is money left over for other goods.
  - What is this type of utility function called?
- Their income is Y, and the good costs p.
  - So their budget constraint says $Y = pQ + M$.

- Want to max: $U(Q) = v(Q) + Y - pQ$.
- FOC: $v'(Q^*) = p$
  - What is v'? (Other than v's first derivative.)

Consumer surplus (2/3)



Consumer surplus (3/3)

- Consumer surplus at a quantity Q^* and a price p^* on the demand curve is defined as the blue shaded area.
- With our consumer from before, this is:

$$\int_0^{Q^*} (p(Q) - p^*)\, dQ = \int_0^{Q^*} (v'(Q) - p^*)\, dQ = \int_0^{Q^*} v'(Q)\, dQ - p^* Q^*$$
$$= v(Q^*) - p^* Q^*$$

  - By the "Fundamental Theorem of Calculus" (FTC).
    - This says that if you integrate a derivative, you get back the original function.

- But $v(Q^*) - p^* Q^* = U(Q^*) - Y$.
  - Consumer surplus is a measure of utility, when agents have quasi-linear preferences.
  - With quasi-linear preferences, money is the unit of utility.
    - So CS is also a measure of the value gained by consumers.
    - Note that Y is the utility they would get when $Q^* = 0$.

Cost functions (OZ 3.1)

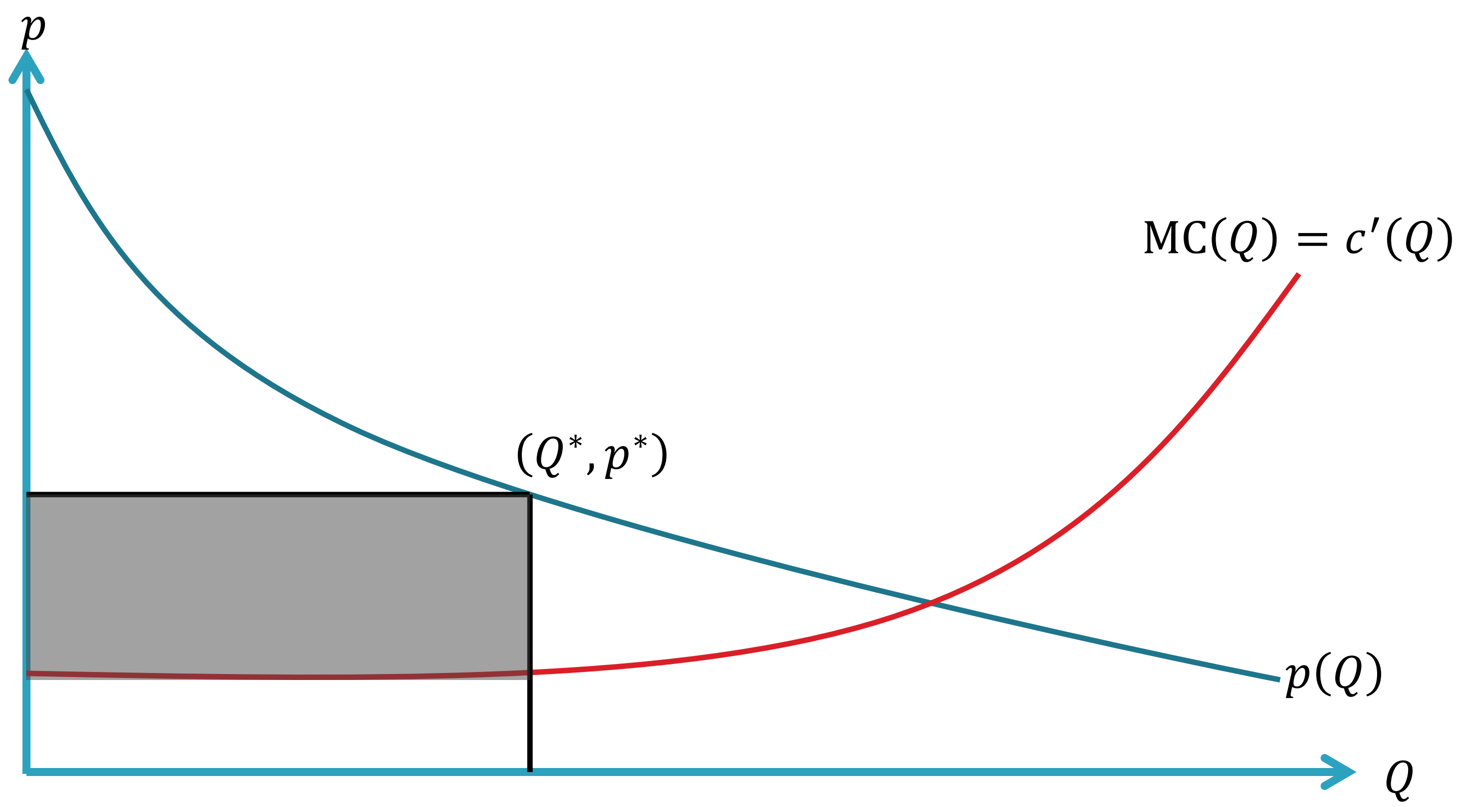
- The cost function, $c(Q)$ gives the total cost of producing Q units.
  - $c'(Q)$ is marginal cost.
  - $\frac{c(Q)}{Q}$ is average costs.
  - When do average costs equal marginal costs?

- Suppose output is produced using $Q = f(L)$ where L is labour, which is paid W per unit.
  - What is the cost function?
  - Example: $Q = (L - \gamma)^{\alpha}$ where $\alpha \in (0,1)$ and $\gamma > 0$.

Profits (1/3)

- We can think of firms as either choosing prices or quantities.
- These give two different versions of the profit function:
  - $\pi(p) = pQ(p) - c\big(Q(p)\big)$
  - $\pi(Q) = p(Q)Q - c(Q)$
  - If $p(y) = Q^{-1}(y)$ for all y then these will give the same result.
- The $p(Q)Q$ term is total revenue.
  - What is marginal revenue?

Profits (2/3)



Profits (3/3)

- The grey shaded area gives producer surplus at a quantity Q^* and a price p^* on the demand curve.
- This area is:

$$\int_0^{Q^*} \left(p^* - \mathrm{MC}(Q)\right) dQ = \int_0^{Q^*} \left(p^* - c'(Q)\right) dQ$$
$$= p^*Q^* - [c(Q^*) - c(0)]$$

  - By the FTC again.

- But $p^*Q^* - [c(Q^*) - c(0)] = \pi(Q^*) + c(0)$.
  - Producer surplus measures profits.
  - Or the value gained by producers.
    - Note that $-c(0)$ is their profit when $Q^* = 0$.

Welfare

- The total value gained by all agents in the economy is consumer surplus plus producer surplus.
  - We call this welfare.
- What quantity maximises welfare?

$$\begin{aligned} W(Q) &= \mathrm{CS}(Q) + \mathrm{PS}(Q) \\ &= v(Q) - pQ + pQ - [c(Q) - c(0)] \\ &= v(Q) - c(Q) + c(0) \end{aligned}$$

- FOC: $v'(Q^*) = c'(Q^*)$
  - or equivalently $p(Q^*) = c'(Q^*)$.
  - Perfect competition maximises welfare!

Monopolists (1/2)

- A monopolist has cost function $c(Q)$ and faces market demand curve $p(Q)$.
  - Profits are $\pi(Q) = p(Q)Q - c(Q)$.

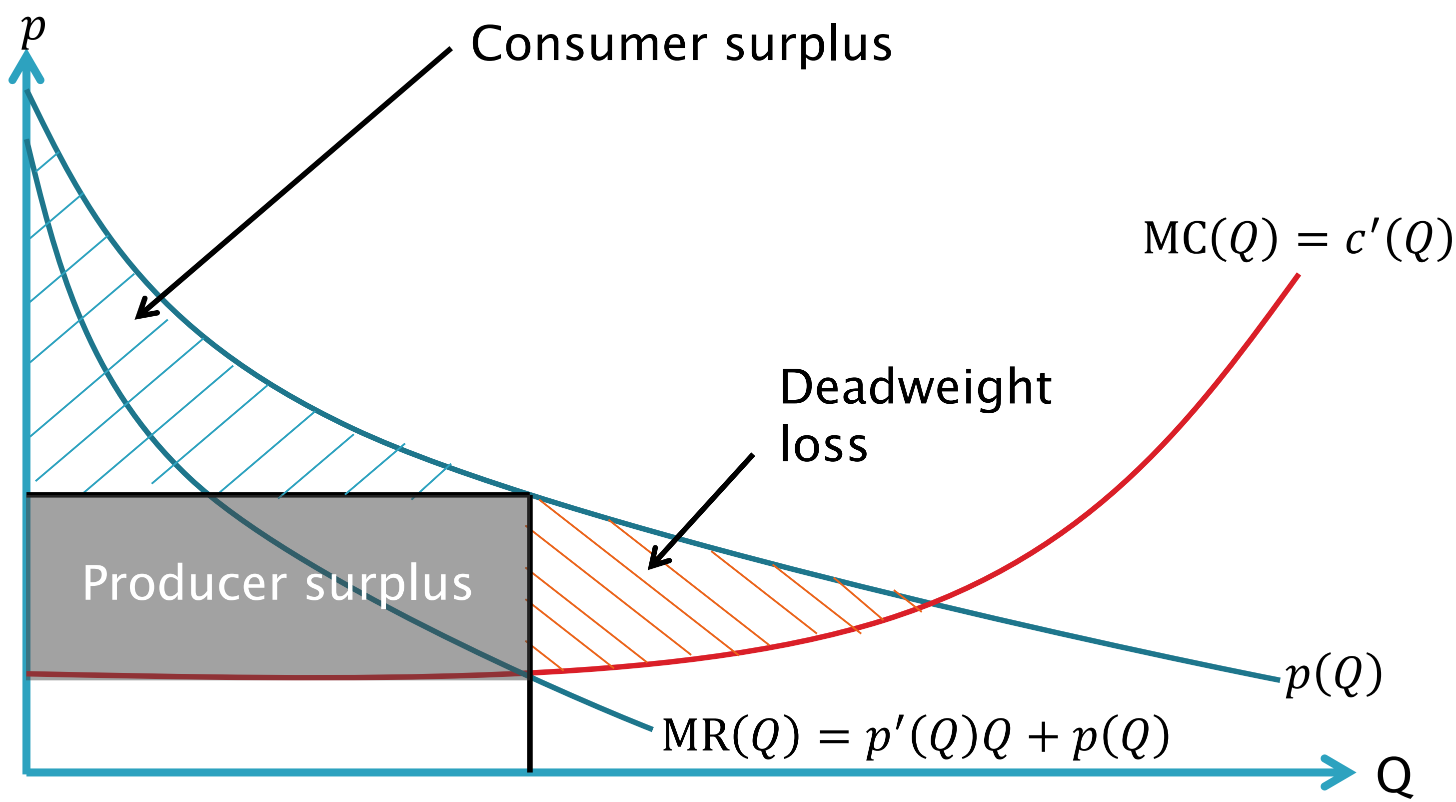
- First order condition:

$$p'(Q^*)Q^* + p(Q^*) - c'(Q^*) = 0$$

- So:

$$\begin{aligned} \mathrm{MR}(Q^*) &= p'(Q^*)Q^* + p(Q^*) \\ &= c'(Q^*) = \mathrm{MC}(Q^*) \end{aligned}$$

Monopolists (2/2)



Monopoly problems

- Suppose $p(Q) = p_0 - p_1 Q$ and $c(Q) = c_0 + c_1 Q$.
  - Show that under monopoly: $Q^* = \frac{p_0 - c_1}{2p_1}$
  - And under perfect competition: $Q^* = \frac{p_0 - c_1}{p_1}$
    - So quantity is halved.
  - What are CS, PS and DWL?

- Suppose $p(Q) = kQ^{-\beta}$ and $c(Q) = c_0 + c_1 Q$.
  - Show that under monopoly: $p(Q^*) = \frac{1}{1-\beta} c'(Q^*)$
    - Mark-up pricing!

Further problems

- Redo the problems on the previous page assuming the monopolist chooses prices rather than quantities.
  - (Using the demand curve rather than the inverse demand curve.)
  - Show your answers are equivalent.

- OZ Ex 3.4
  - Questions 3, 4, 5 and 6.
- OZ Ex 5.7
  - Questions 1, 2 and 7.
- OZ Extra exercises:
  - http://ozshy.50webs.com/io-exercises.pdf
  - Set #4

Conclusions

- CS is the value gained by consumers.
- PS is the value gained by producers.

- Monopoly is inefficient and results in DWL.

- Key skills:
  - Be able to work with linear and iso-elastic demand functions.
  - Calculate elasticities etc.
  - Maximise profit, maximise welfare.