NU Econ 101 Lecture 13: Oligopoly

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Where are we now?

Introduction to oligopoly (1)

We've looked at what happens when there is one firm in a given industry, i.e., a monopoly. **What if there are just a few?**

Oligopoly

A form of industry (market) structure characterized by a few dominant firms.

We want to study how firms in an oligopoly behave, evaluate the welfare consequences, and consider government policy.

Introduction to oligopoly (2)

How do firms in an oligopoly behave?

Three models:

1. Cartels: act together like a monopolist.
2. Cournot competition: compete on quantity.
3. Bertrand competition: compete on price.

Where are we now?

Cartels

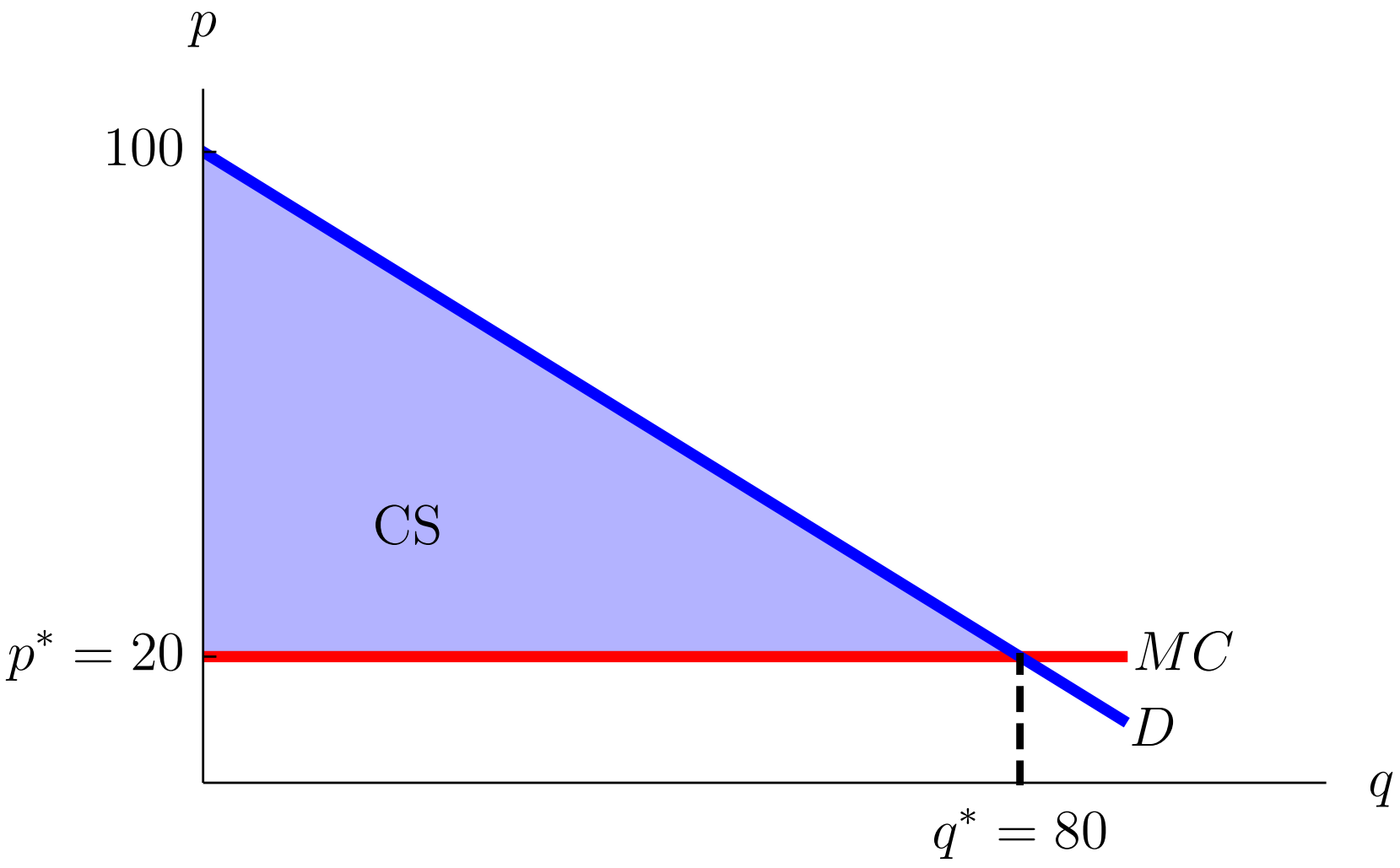
In a **cartel**, firms conspire to behave like a monopolist.

Let's use an example:

- There are two firms (a **duopoly**), firm A and firm B.
- They face market demand $p(q) = 100 - q$.
- Each firm has $TVC(q_i) = 20q_i$.
  - Then $MC(q_i) = 20$.

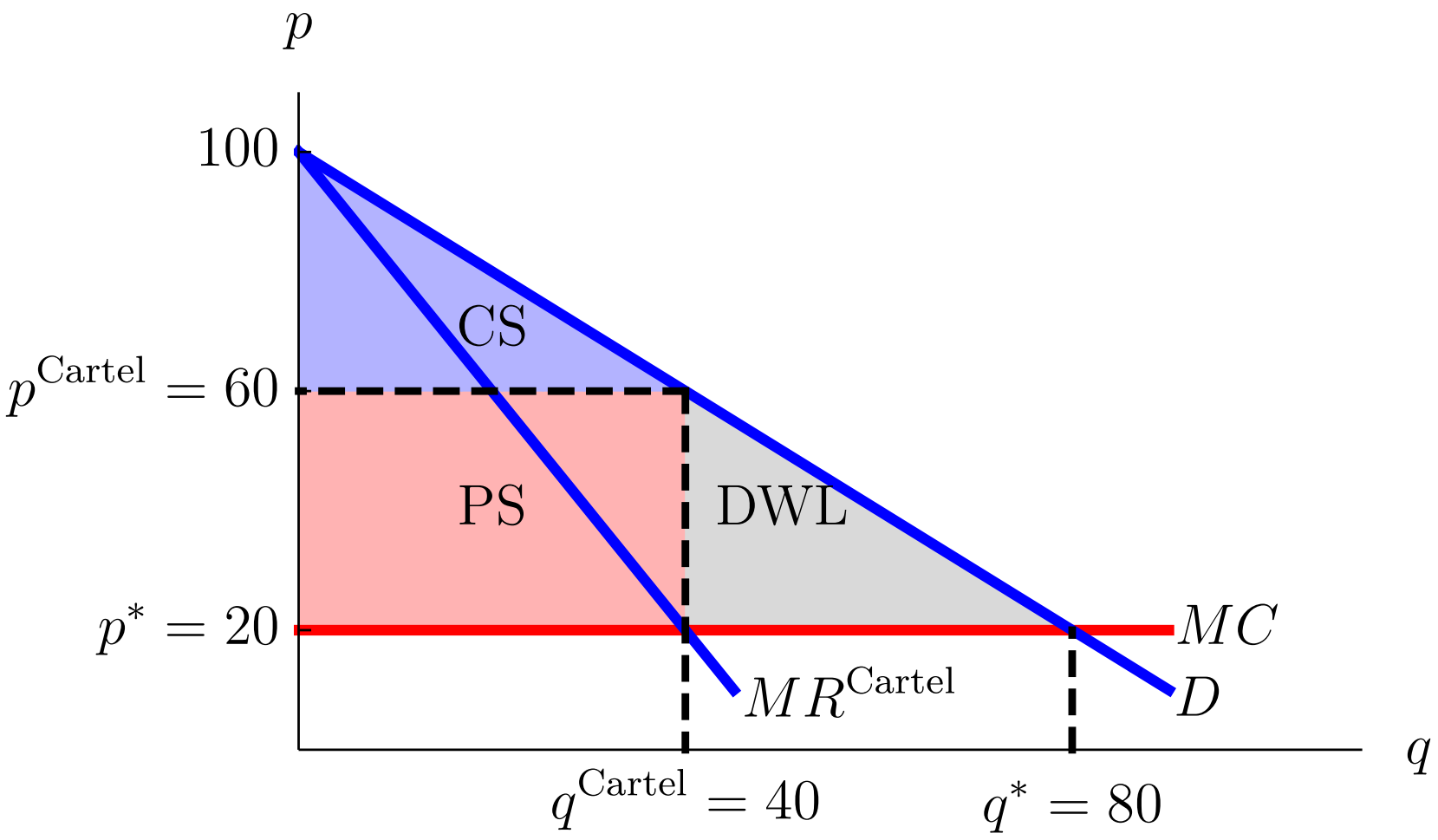
We'll first look at the social optimum, then the cartel outcome.

Socially optimal outcome



CS $= \frac{80 \cdot 80}{2} = 3200.$ **PS** $= 0.$ **TS** $= 3200.$

Cartel outcome



CS $= \frac{40 \cdot 40}{2} = 800.$ **PS** $= 40 \cdot 40 = 1600.$ **TS** $= 2400.$

Sustaining a cartel (1)

In a cartel, firms act as if they were a monopoly. That is, **they act as one**, considering $q = q_A + q_B$:

$$\text{Revenue} = q \cdot p(q) = 100q - q^2 \quad \text{and} \quad MR(q) = 100 - 2q$$

Setting $MR(q) = MC(q)$ yields $q^{\text{Cartel}} = 40$, i.e., $q_A = q_B = 20$.

Profits for each firm: $60 \cdot 20 - 20 \cdot 20 = 800$.

Sustaining a cartel (2)

In a cartel, each firm has incentives to cheat (overproduce):

Conditional on $q_B = 20$, look at A's revenue:

$$A\text{'s Revenue} = q_A \cdot p(q_A + 20) = q_A(100 - q_A - 20) = 80q_A - q_A^2$$

Then A's maginal revenue is $MR(q_A) = 80 - 2q_A$.

Equating marginal revenue to marginal cost gives:

$$80 - 2q_A = 20 \quad \Longrightarrow \quad q_A = 30$$

Recall they were supposed to produce $q_A = 20$ in the cartel!

Sustaining a cartel (3)

If firm A produces 30 and firm B produce 20. Then the market price is $p(50) = 100 - 50 = 50$.

Profits

- Firm A's profits are $50 \cdot 30 - 20 \cdot 30 = 900$
  - Firm A has gained 100.
- Firm B's profits are $50 \cdot 20 - 20 \cdot 20 = 600$
  - Firm B has lost 200.

Firms gain, at the expense of other firms, by cheating on a cartel.

Sustaining a cartel (4)

The intuition:

In a cartel, firms limit their production because they take into account not just the affect of producing an extra unit on the price that they sell their other units, but also the affect on the price at which the other firms sell their output.

But, there are temptations for each firm to cheat. If a firm focuses on its private interests, it can increase its profits.

Sustaining a cartel (5)

How might cartels be sustained in the real world?

- Could sign a contract to produce at the cartel level.
  - This is illegal!
- Repeated interaction between firms.
  - You could cheat on the cartel. But if you do, we all will also, so hurts you in the future.
  - We'll see this tomorrow when we do a little game theory.

Sustaining a cartel (6)

As a society, do we want a cartel to sustain?

- No. They reduce quantity and increase price, yielding deadweight loss.

Cartels are generally illegal.

- But **tacit collusion** is still a problem.
  - Two firms may never communicate but still maintain an unspoken agreement to limit quantity.

Examples of cartels (1)

Organization of the Petroleum Exporting Countries (OPEC).

- "In accordance with its Statute, the mission of the Organization of the Petroleum Exporting Countries (OPEC) is to coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital for those investing in the petroleum industry."
- Cannot be held to antitrust enforcement in other jurisdictions by virtue of the doctrine of state immunity under public international law.

Examples of cartels (2)

Unilever and Proctor & Gamble in Europe (2002-2005)

- 2011: "Unilever and Procter & Gamble have been hit with fines totalling 315.2m (281m) for fixing the price of washing powder in eight European countries."
  - From this article in *The Guardian*.

Examples of cartels (3)

Airline cargo internationally (2000-2006)

- Many airlines were charged with collusion over cargo prices.
- In Europe, substantial fines were imposed then overturned.
  - See this article in *The Financial Times*.
- In USA, a civil case airlines resulted in significant settlements.
  - See this article in *The New Zealand Herald*.

Where are we now?

Cournot competition

So what happens when firms act in their individual best interests?

Let's use the same example:

- There are two firms (a **duopoly**), firm A and firm B.
- They face market demand $p(q) = 100 - q$.
- Each firm has $TVC(q_i) = 20q_i$.
  - Then $MC(q_i) = 20$.

Best responses

Each firm's optimal production depends on how much the other firm is producing. **Firms best respond to eachother:**

- Firm A's revenue:

$$\text{Revenue} = q_A(100 - q_A - q_B) = 100q_A - q_A^2 - q_Aq_B$$

- So marginal revenue is $MR = 100 - 2q_A - q_B$. Equate with $MC = 20$ to get:

$$q_A = \frac{80 - q_B}{2}$$

- Doing the same for firm B gives $q_B = \frac{80-q_A}{2}$.

Cournot-Nash equilibrium (1)

In a Nash Equilibrium, each player best responds to all others.

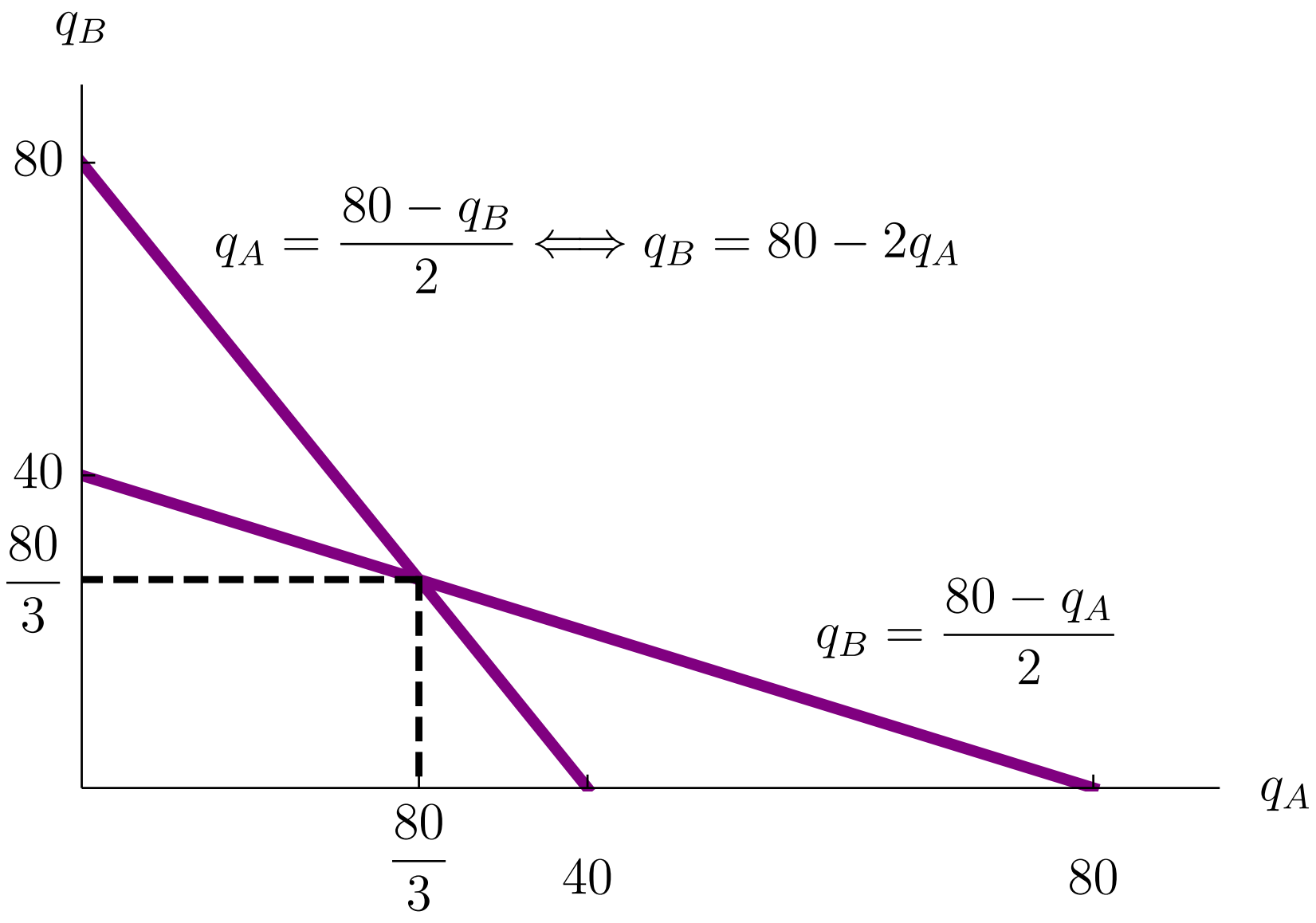
- We'll talk more about Nash equilibrium tomorrow.

We solve the two best responses simultaneously:

$$q_A = \frac{80 - q_B}{2},$$
$$q_B = \frac{80 - q_A}{2},$$

which yields $q_A = q_B = 80/3$.

Cournot-Nash equilibrium (2)



Cournot-Nash equilibrium (3)

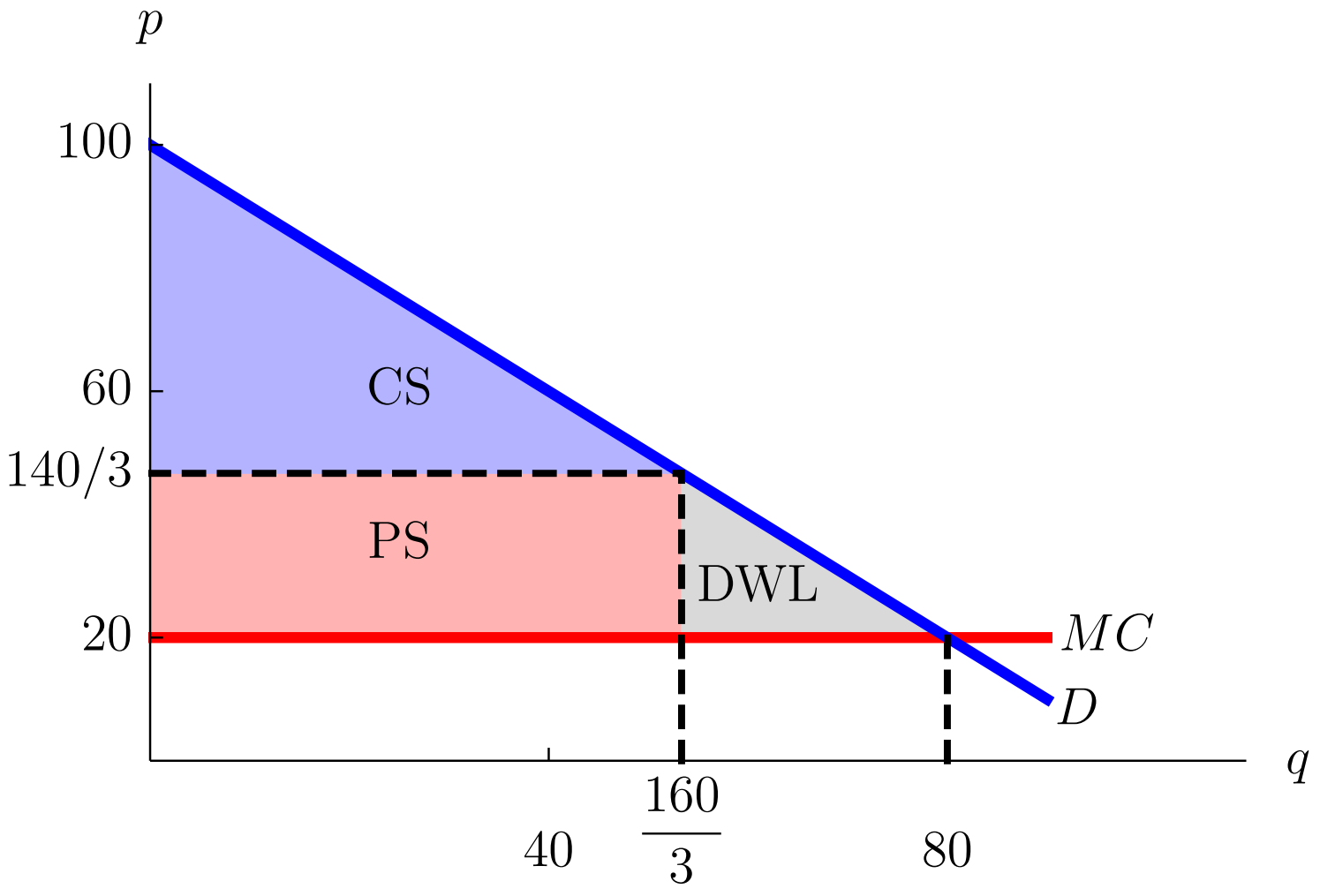
At the Cournot-Nash equilibrium, $q_A = q_B = \frac{80}{3}$.

Therefore, the total quantity is $q = q_A + q_B = \frac{160}{3}$.

Market price is $p(q) = 100 - \frac{160}{3} = \frac{140}{3}$.

Firm i's profits are $q_i \cdot p(q) - 20q_i = \frac{80}{3}\left(\frac{140}{3} - 20\right) = \frac{6400}{9}$.

Cournot-Nash equilibrium (4)



$$\textbf{CS} = \frac{\frac{160}{3}\cdot\left(100-\frac{140}{3}\right)}{2} = \frac{12800}{9}. \qquad \textbf{PS} = \frac{160}{3}\cdot\left(\frac{140}{3}-20\right) = \frac{12800}{9}.$$

Summary

Let's summarize what we've seen for our example:

	q	p	CS	PS	TS
Social optimum	80	20	3200	0	3200
Cournot	53	47	1422	1422	2844
Monopoly/Cartel	40	60	800	1600	2400

As N $\longrightarrow \infty$, Cournot $\longrightarrow$ Social optimum

When we did our Cournot example, we did it with a duopoly.

- Remember a duopoly is two firms.

If we instead did it with $N > 2$ firms, the equilibrium output would be higher and the equilibrium price lower.

If we see what happens as we get more and more firms, i.e. as $N \to \infty$, we find that the cournot equilibrium converges to the socially optimal outcome.

Where are we now?

Bertrand competition (1)

So far we have assumed that firms choose quantities which result in market prices through the market inverse demand.

An alternative: Instead, let firms choose prices, and those prices will result in how much quantity they sell.

Assumptions:

- Consumers buy the cheapest alternative.
- If both alternatives have equal prices, half of consumers purchase each good.
- Each of the competing firms can supply the whole market at any price.

Bertrand competition (2)

Returning again to our example:

- There are two firms (a **duopoly**), firm A and firm B.
- They face market demand $p(q) = 100 - q$.
- Each firm has $TVC(q_i) = 20q_i$.
  - Then $MC(q_i) = 20$.

Just like we did for Cournot, we want to find each firm's best response to the other firm's price.

Bertrand competition (3)

Best response is to just undercut your opponent's price.

- Want to undercut the opponent's price to get whole market.
- Want to undercut by as little as possible to sell at the highest possible price.

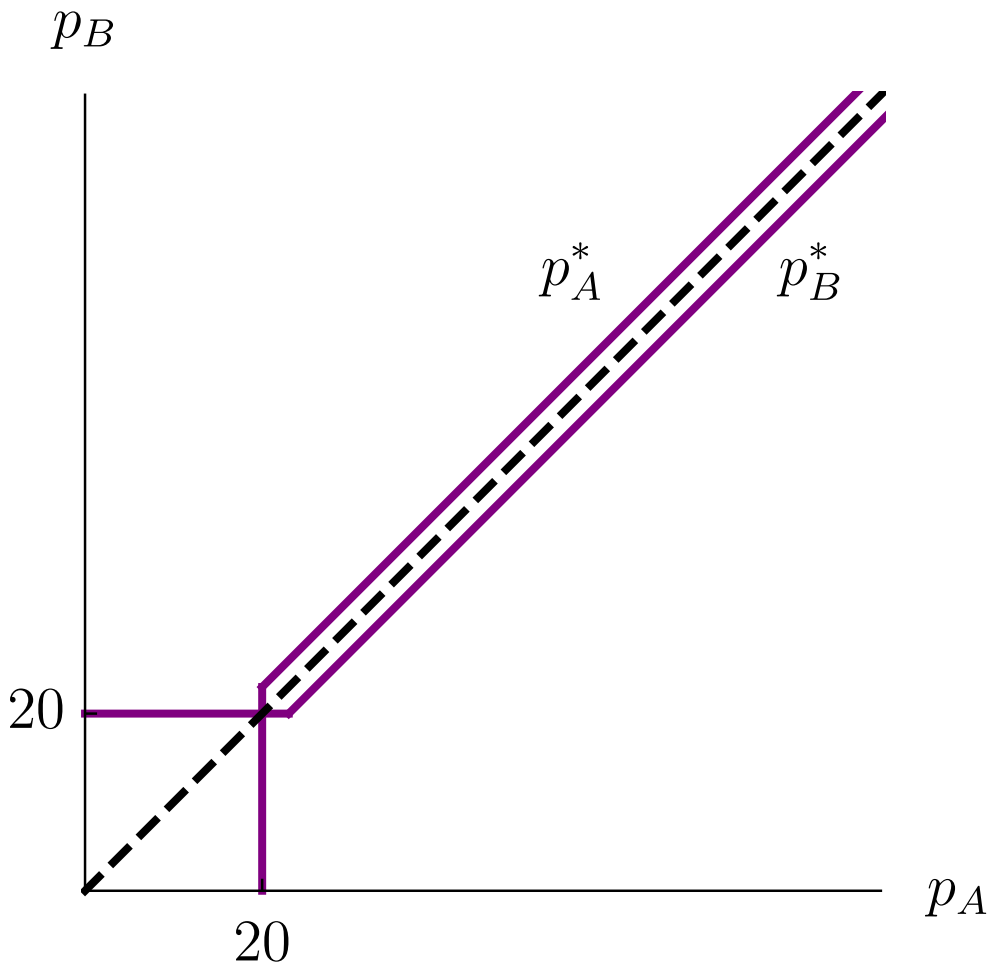
However, if the opponent's price is below your marginal cost, you would lose money by producing at a price below that.

Therefore:

$$p_A^* = \begin{cases} p_B - \varepsilon & \text{if } p_B > MC_A \\ MC_A & \text{if } p_B \leq MC_A \end{cases},$$

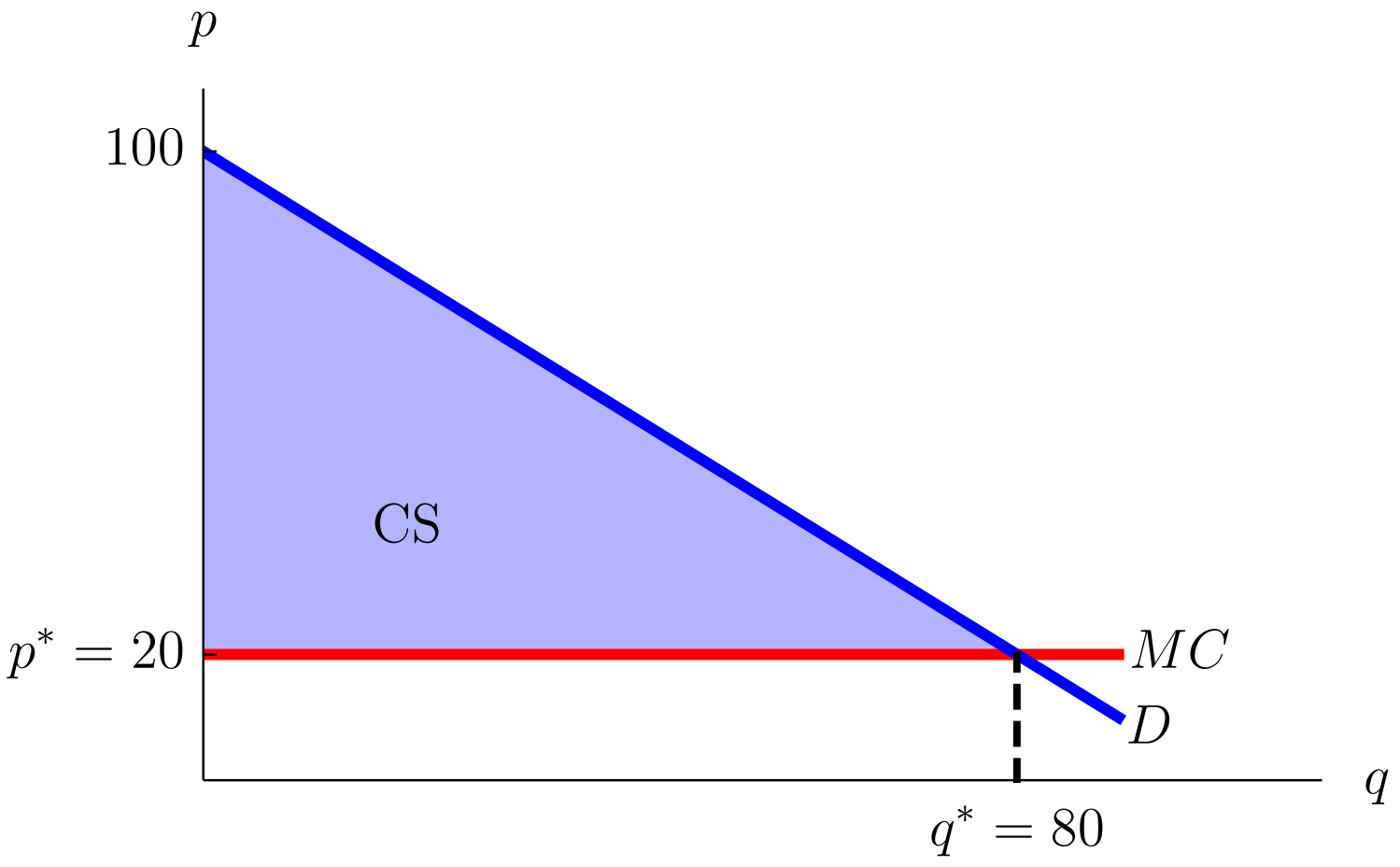
with $\varepsilon > 0$ as small as possible. And similar for p_B^*.

Bertrand competition (4)



The intersection (equilibrium) occurs at $p_A = p_B = MC$.

Bertrand competition (5)



We get the socially optimal outcome!

Bertrand versus Cournot

Cournot suggests a duopoly will produce less quantity than optimal and sell at a higher than optimal price.

Bertrand suggests a duopoly will produce the optimal quantity and sell at the market clearing price.

Who is right?

- If capacity and output can be easily changed, Bertrand is generally a better model of duopoly competition. Otherwise Cournot is typically better. That is, it depends on the industry.
- What does *better* mean? Remember economics is a positive science. *Better* means more accurate predictions.

Where are we now?

Monopolistic competition

Often, in the real world, we have monopolistic competition.

Monopolistic competition

A common form of industry (market) structure characterized by a large number of firms, no barriers to entry, and product differentiation.

Examples: Just about all consumer goods, restaurants, etc.

Product differentiation (1)

Firms differentiate their products to achieve market power.

Some products are more differentiated than others. Degree of differentiation depends on:

- Tastes for differentiation v. conformity.
- Costs of differentiation.

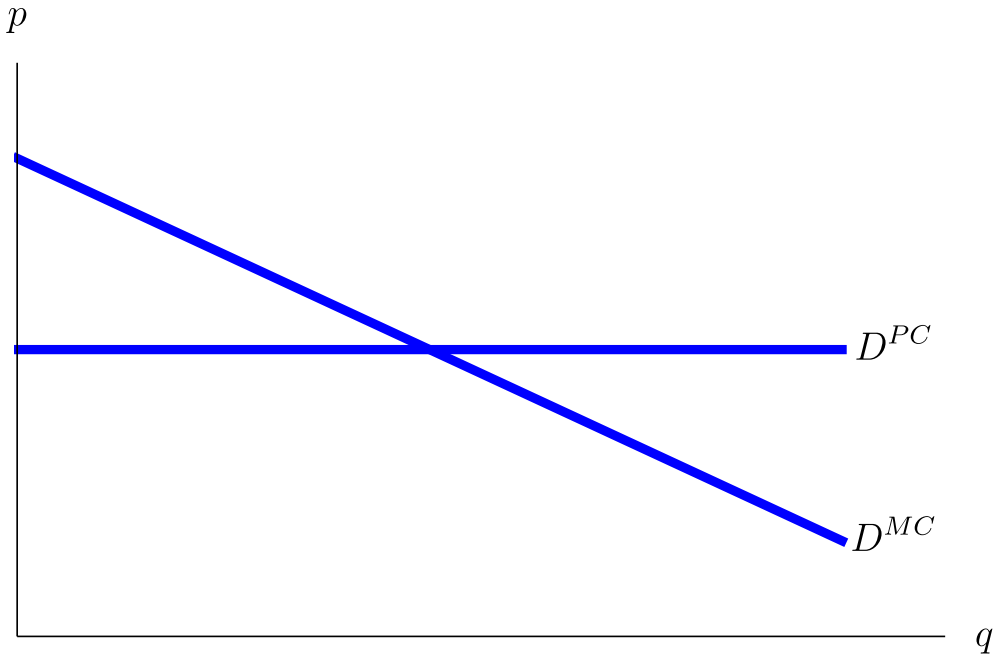
Why is house color more differentiated than sidewalk color?

- Differentiating sidewalk color would be very expensive.
- Differentiating house color is relatively cheap.

Product differentiation (2)

Demand curve facing a . . .

- perfectly competitive firm: D^{PC}
- monopolistically competitive firm: D^{MC}



Product differentiation reduces the elasticity of demand.

Profit maximization and cost minimization

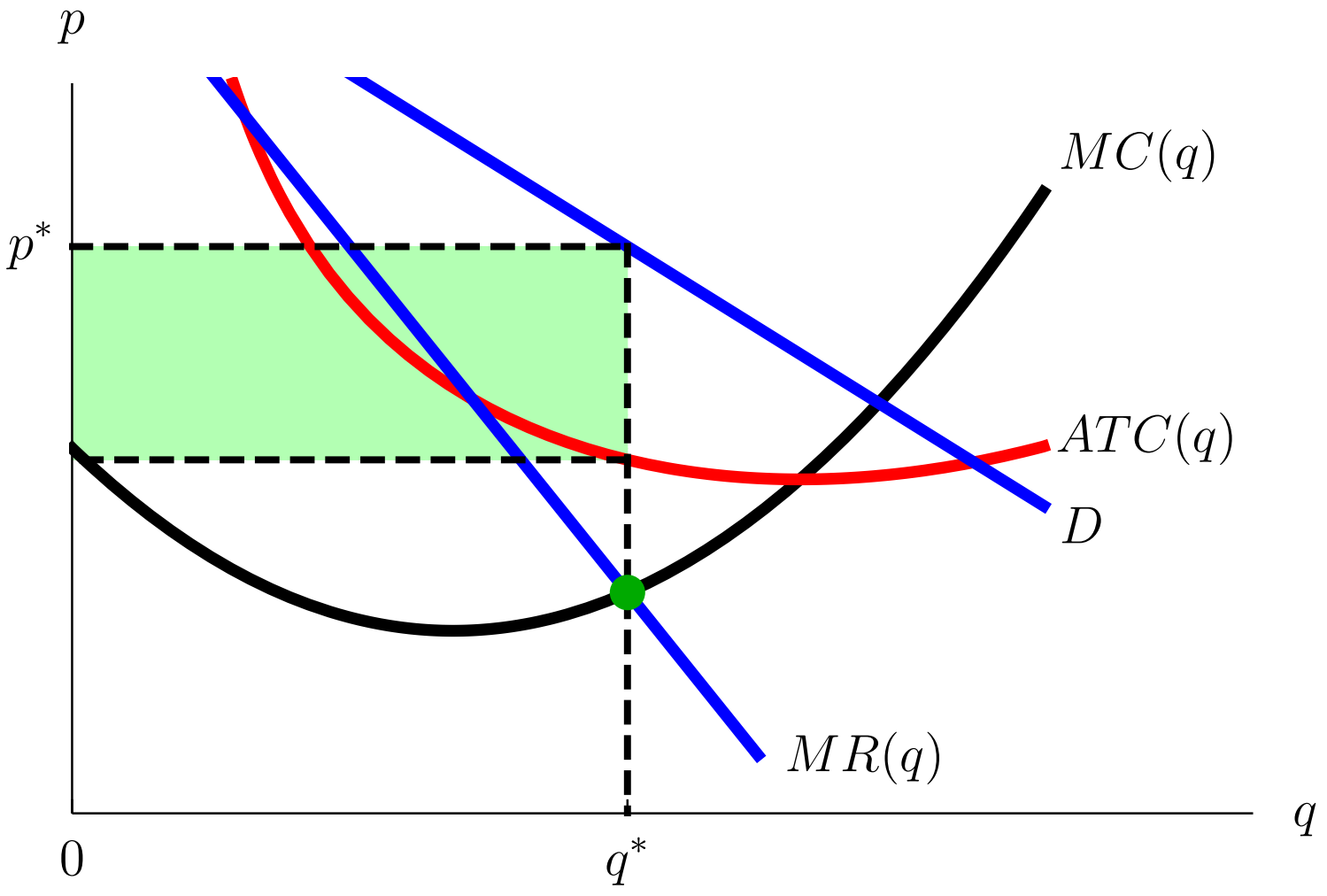
Monopolistically competitive firms solve $MR(q) = MC(q)$.

- Remember this is true in all cases!

The short-run and long-run stories of monopolistically competitive firms are much like their analogs with perfectly competitive firms.

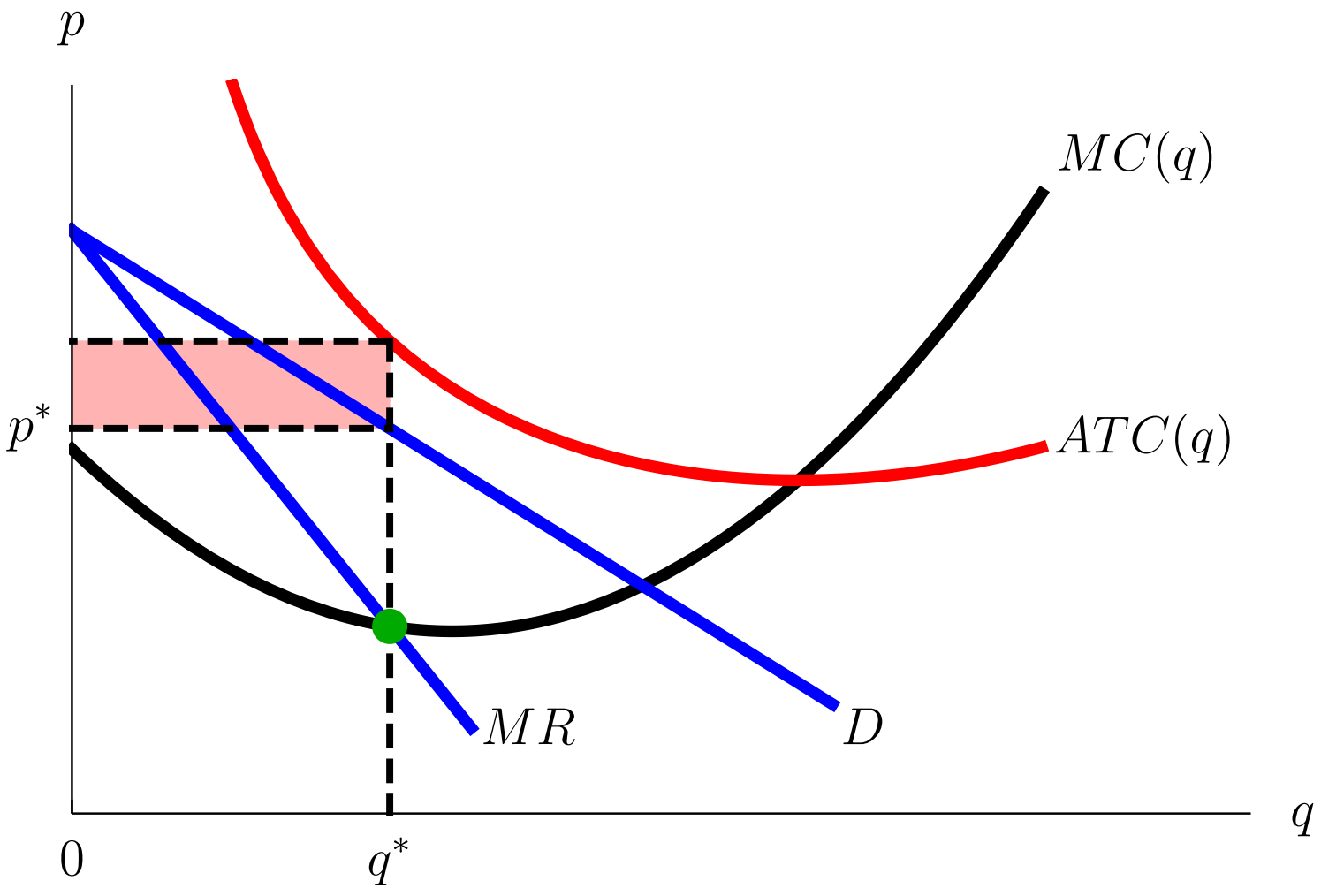
- Firms may make profits or losses in the short-run.
- Firms make zero profits in the long-run due to entry/exit.

Monopolistically competitive firm, short-run profits



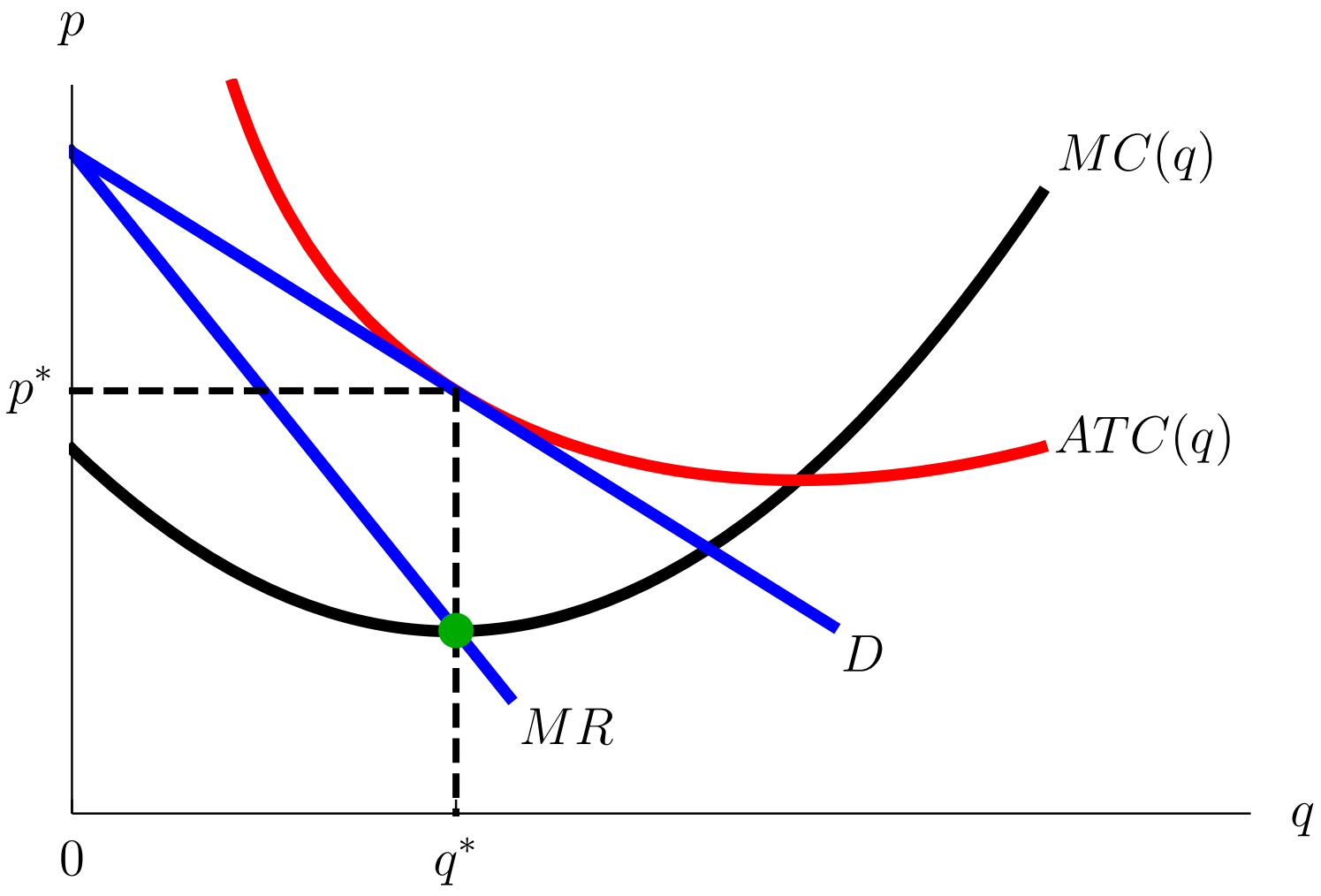
Green area is profits. Green dot is the optimal production point.

Monopolistically competitive firm, short-run losses



Red area is losses. Green dot is the optimal production point.

Monopolistically competitive firm, long-run



No profits or losses. Green dot is the optimal production point.

Where are we now?

Useful problems

Useful problems:

- Chapter 14: 4, 12, 13.
- Chapter 15: 1, 4, 10, 11.