LECTURE 3.5

OLIGOPOLY – THE COURNOT MODEL

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Assumptions:

- homogeneous product
- firms compete by choosing quantity simultaneously
- the market price clears the market
- firms interact in a single period
- no entry

We solve for a Nash equilibrium to a simultaneous game. Each firm chooses optimal output given their rivals' output. No firm will have an incentive to change its output decision given the other firms' choice.

OLIGOPOLY – THE COURNOT MODEL

In a Nash equilibrium (NE) each firm maximises profits given the strategies (outputs) of their rivals

Steps to solve for the Nash equilibrium

1. work out the objective function (profits) for each firm

$$\pi_i(q_1, q_2, \dots) = q_i P(q_1 + q_2) - C(q_i)$$

2. optimisation: derive reaction functions for each firm
   - profit maximisation given rival output → reaction functions
3. solve simultaneously for each reaction function → equilibrium prices and quantities
   - in a Nash equilibrium, each firm must operate on their reaction function

OLIGOPOLY – THE COURNOT MODEL

Start with a simple example in which two firms (A & B) have constant marginal cost equal to zero:

$$MC_A = Mc_B = 0$$

The industry demand curve is given by:

$$P = 100 - Q$$

Industry output equals the sum of each firms output so:

$$Q_A + Q_B = Q$$

The anticipated or residual demand curve for firm A is given by:

$$P_A = (100 - \overline{Q_B}) - Q_A$$

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The MR curve for firm A is given by:

$$MR_A = (100 - \overline{Q_B}) - 2Q_A$$

(This is because $Revenue_A = P_A Q_A = \big((100 - \overline{Q_B}) - Q_A\big)Q_A$. Take the derivative to get marginal revenue.)

The usual profit maximizing rule applies so we set marginal revenue equal to marginal cost to give:

$$0 = (100 - \overline{Q_B}) - 2Q_A$$

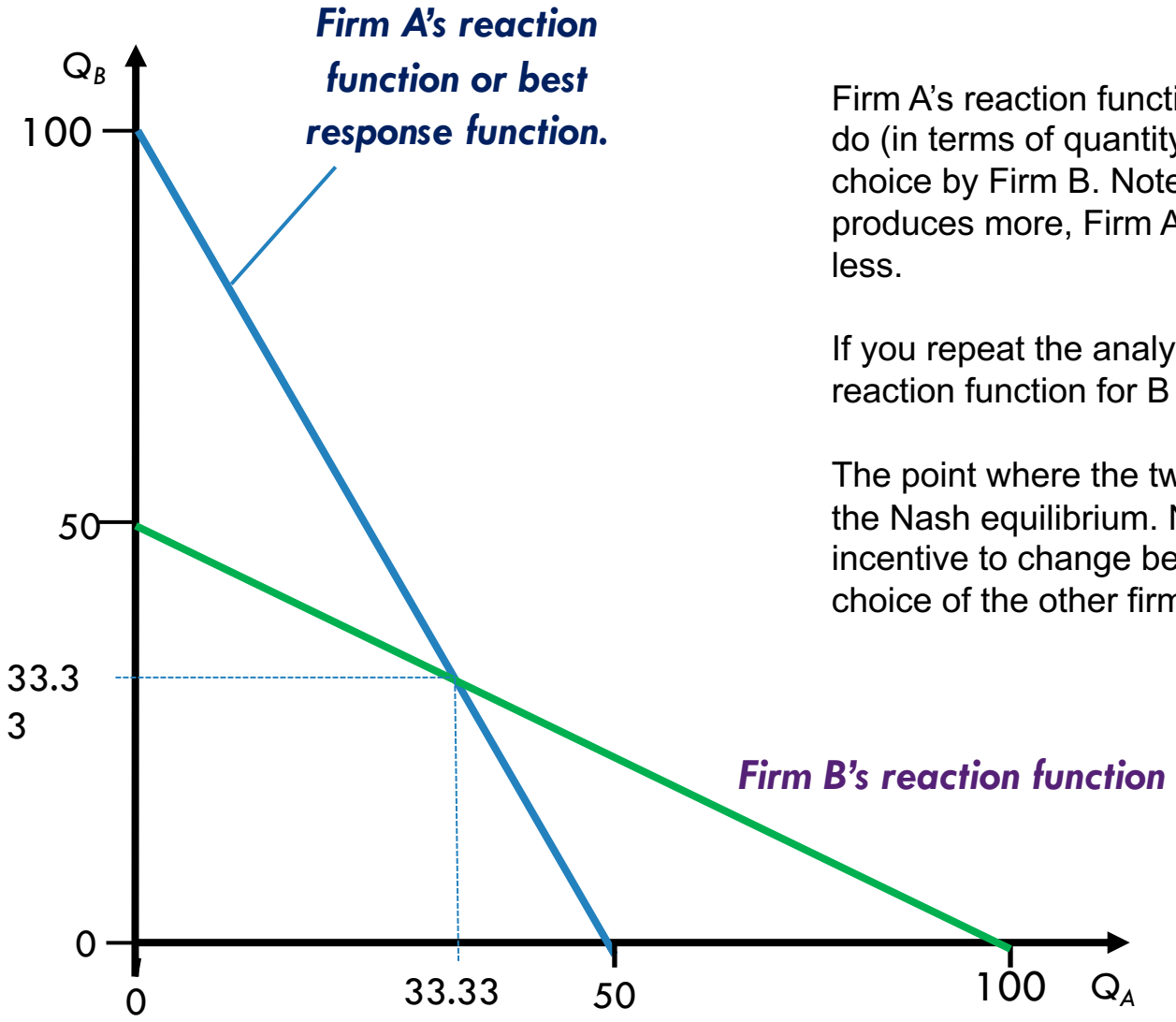
Or

$$Q_A = 50 - 0.5Q_B$$

Or

$$Q_B = 100 - 2Q_A$$

Which represents the firm A's ***reaction function.***



Firm A's reaction function tells us what Firm A should do (in terms of quantity choice) in response to a choice by Firm B. Note that here when firm B produces more, Firm A's best response is to produce less.

If you repeat the analysis you get an analogous reaction function for B (shown in green).

The point where the two curves intersect represents the Nash equilibrium. Neither A nor B will have any incentive to change behaviour (output) given the choice of the other firm.

OLIGOPOLY – THE COURNOT MODEL

We can solve the Cournot model with many firms.

- If firms have the same cost functions, it is easier to use symmetry rather than solving n equations in n unknowns

What can we say about the outcome of the Cournot model?

- Output is lower and price higher than what it would be under perfect competition.
- Output is higher and price lower than what it would be under monopoly.

COMMITMENT

Consider a commitment such as adopting a product innovation that reduces variable production cost or one about positioning a product in the market. Assume that is such that ***rivals are aware*** of it and it ***cannot be reversed and is therefore credible.***

Consider the following timing:

- ***Stage 1*** – firm A makes commitment.
- **Stage 2** – firms compete through quantity choices (Cournot).

Assume new equilibrium is reached quickly.

COMMITMENT

We can distinguish between:

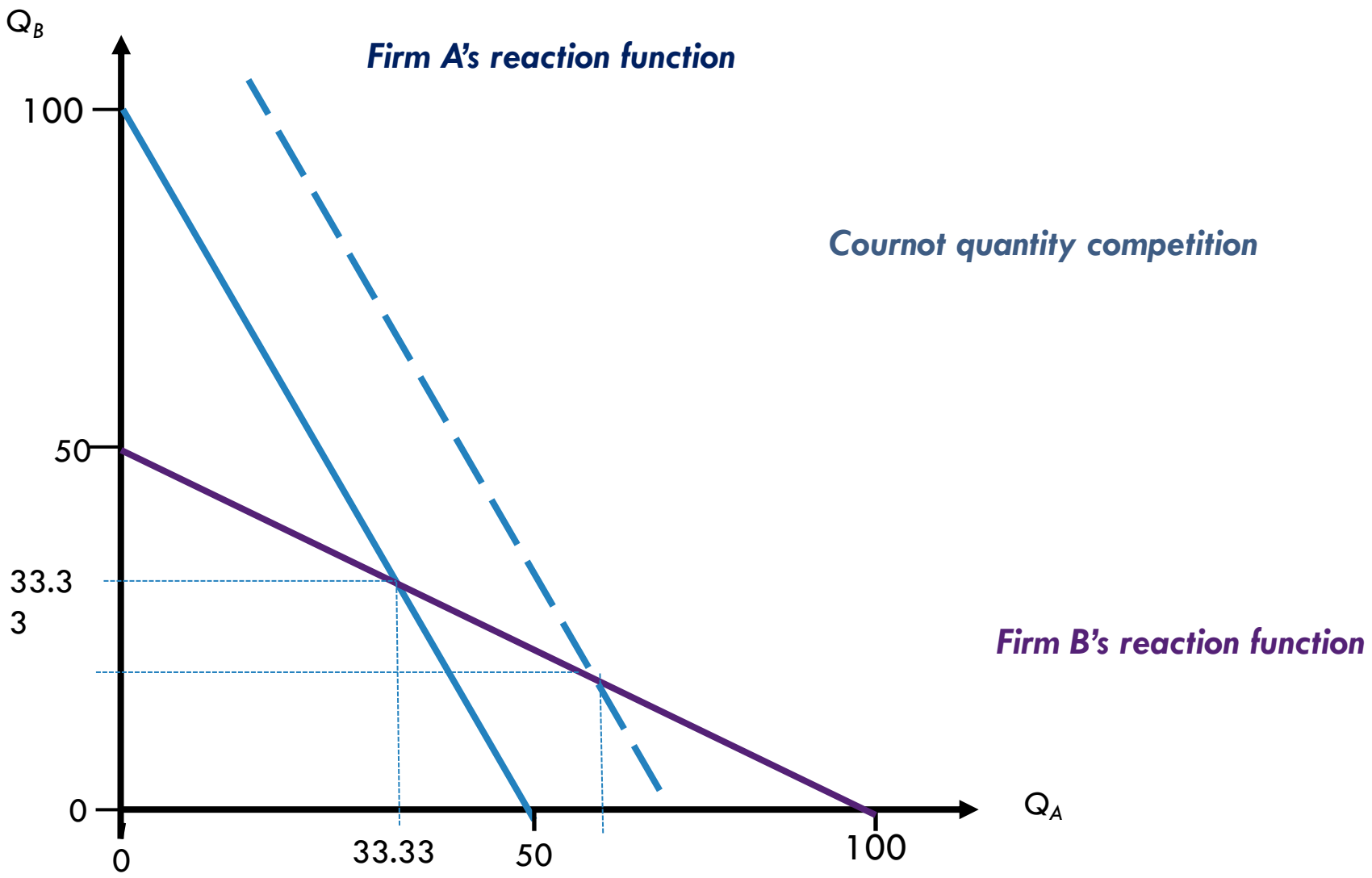
- **Tough commitments** – those that are bad for competitors. For example, the expansion of production facilities in a Cournot model.
- **Soft commitments** – those that are good for competitors. For example, the elimination of production facilities in a Cournot model.

TOUGH COMMITMENTS

For a tough commitment, firm A will produce more than if it had not made commitment. That is, a rightward shift in the reaction function.

The effect will be to see firm B respond by reducing its own output causing market price to be higher. The beneficial strategic effect could outweigh the negative direct effect. Note that the direct effect here is negative – the NPV in the absence of a response is negative.

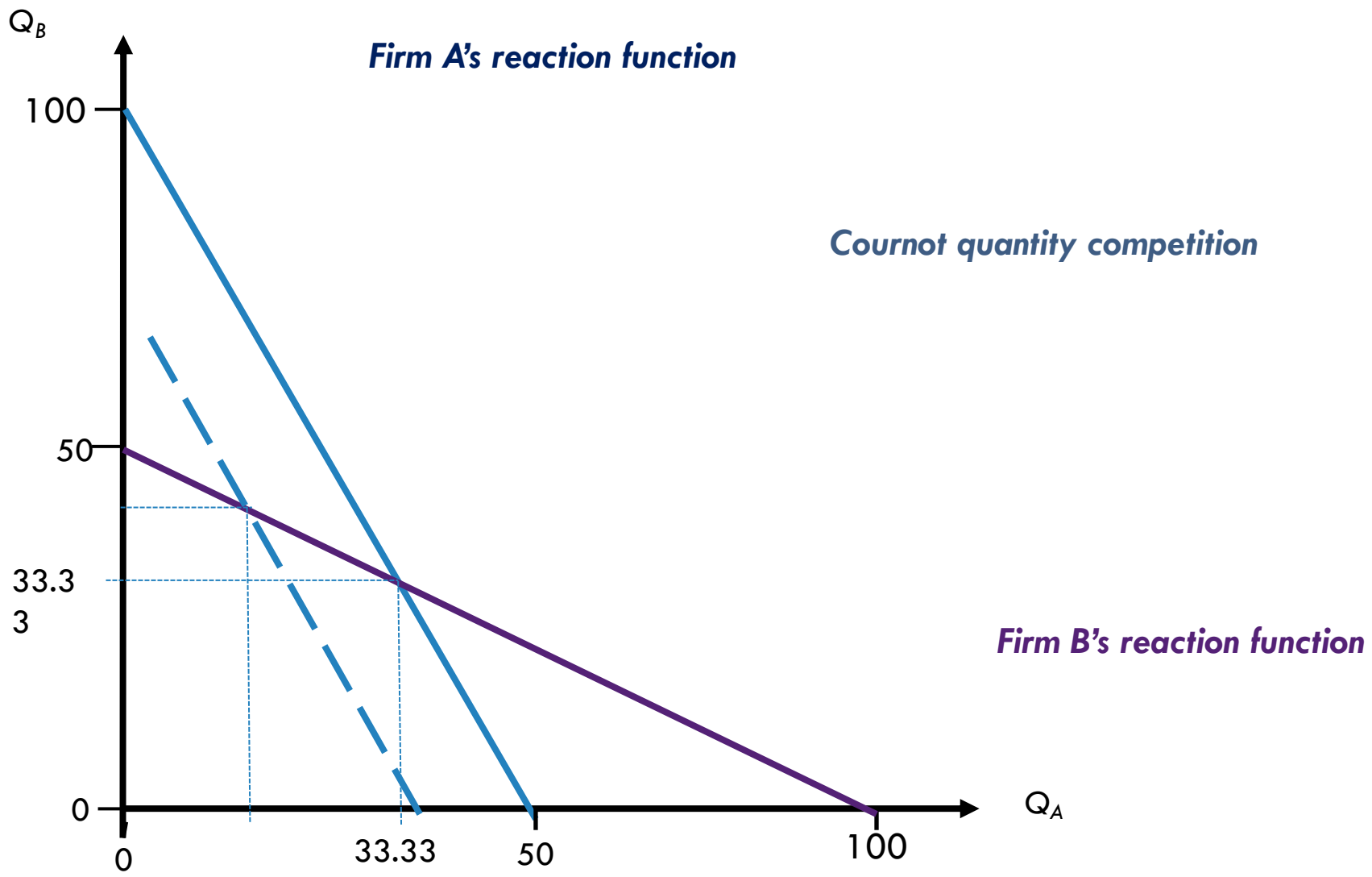
If the strategic effect outweighs the negative direct effect, the firm should go ahead and make a commitment.


Q_B
Firm A's reaction function
100
50
33.3
3
0
0
33.33
50
100
Q_A
Cournot quantity competition
Firm B's reaction function

SOFT COMMITMENTS

Suppose that a firm enters another market and in doing so raises its cost of production. Firm A will produce less than if it had not made commitment. That is, a leftward shift in the reaction function. The effect will be to see firm B respond by increasing its own output. There is a negative strategic effect here.

Firm should go ahead and make commitment only if the beneficial effect (entry into new market) exceeds negative strategic effect.


Q_B
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