RBB | Economics

Pricing theory applied to merger analysis

Prepared for Pricing Theory class at Aalto University

Paula Mäkelä, Associate Principal, RBB Economics

5 October 2022

Roadmap

RBB | Economics

1. **Motivation and the general idea of merger simulation**
   - Motivation: Why pricing theory is important for economists assessing mergers?
   - Merger simulation: implementation
   - Examples
2. **Example of a merger simulation model: Bertrand-Edgeworth**
   - Introduction
   - Bertrand-Edgeworth cycles and the solution concept
   - Merger effects
3. **Applications of Bertrand-Edgeworth model**
   - EC cases
   - Back-of-the-envelope calculation

Motivation and the general idea of merger simulation

Motivation: Why pricing theory is important for economists assessing mergers?

RBB | Economics

Merger assessment requires predicting the likely effect of an event before it occurs

- Therefore, it requires a **theoretical framework**-based tool which can estimate the likely effect that the event (the merger) will have on competition

Merger simulation model is a tool to quantitatively predict the competitive effect of a proposed merger through the application of a (well-accepted) economic model of competitor interaction (in equilibrium)

- **quantatively = measure change in prices**
- **competitive effect = change in prices**

Merger simulation: implementation procedure

RBB Economics

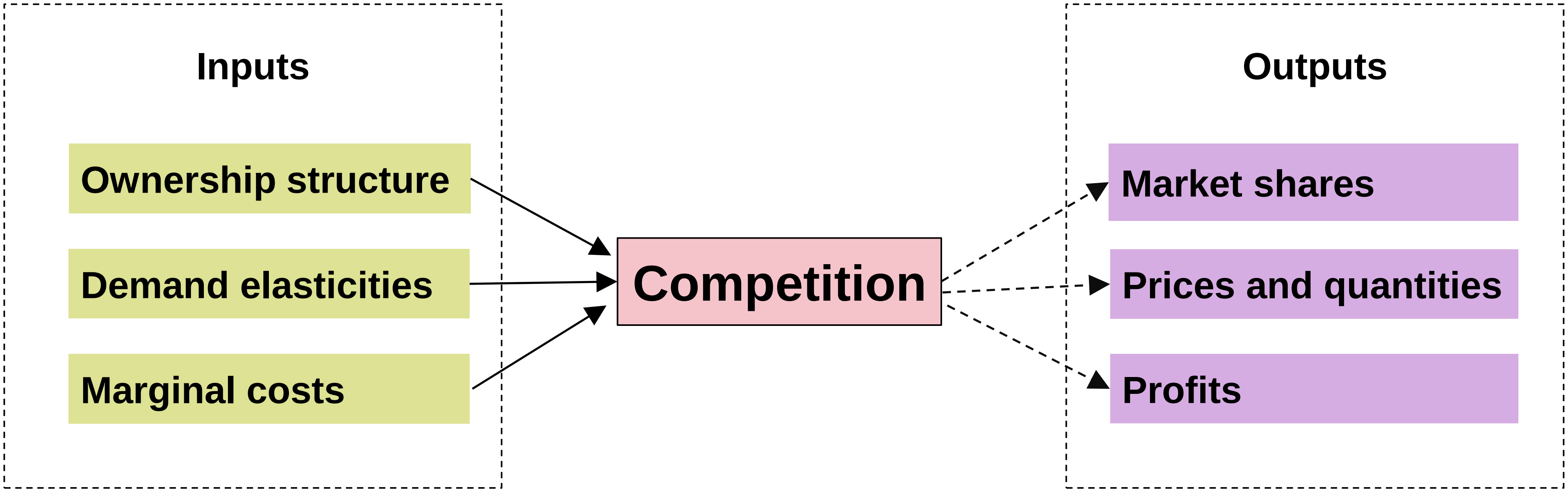
1. Identify the nature of competition and the merger simulation model best describing the market
2. Identify and collect the information available
3. Calibrate the model replicating the **pre-merger** market equilibrium using the available information
4. Identify the changes of ownership structure (and possibly other parameters such as costs) **post-merger**
5. Calibrate the model to predict the **post-merger** market equilibrium using pre-merger calibrated model and post-merger changes

Implementation procedure – how markets work

Firms rely on information on demand elasticities, their marginal costs and the ownership structure in order to set prices or quantities

These decisions give rise to market shares and profits

Ideally and intuitively, merger simulation would produce output in an analogous manner and recreate the decision choice of firms based on the information available to them



Implementation procedure – calibrating the model

- All information is not known to a market outsider. Only public data are readily available:
  - Market shares, prices, quanties and ownership structure
  - Demand elasticies can usually be proxied (through industry studies) or estimated through econometric analysis (e.g. BLP demand estimation)
- Merger simulation uses the pre-merger observable inputs and equilibrium conditions to recover unobservable firm and market specific factors – this is refered to as **calibrating the model**
- With the model calibrated at the pre-merger model inputs, merger simulation re-evaluates the model considering post-merger changes in ownership structure and potential efficiency gains.
- The purpose of the merger simulation is to establish the post-merger market equilibrium in the same way as the decision choice of firms based on the (recovered through pre-merger model calibration) information available to firms.

Merger simulation: Example 1

RBB | Economics

Bertrand competition (homogeneous product, no capacity constraints)

- Before merger: 3 firms (all active in the market), after merger: 2 firms
- No efficiencies due to the merger
- Price observed before the merger: $P = 5$

What will be the price after the merger?

- Equilibrium condition (before the merger): $P = MC$
- Solve for marginal cost: $MC = 5$
- Equilibrium condition after the merger: $P = MC$

Predicted price after the merger: 5

<u>Model validation:</u> What if before the merger each firm has charged a different price for its product?

Merger simulation: Example 2

RBB | Economics

Bertrand competition (homogeneous product, no capacity constraints)

- Before merger: 3 firms with different marginal costs: $MC_1 = 3, MC_2 = 4, MC_3 = 5$
- After merger: 2 firms (firms with marginal costs of 3 and 4 merge)
- No efficiencies due to the merger
- Price observed before the merger: $P \approx MC_2 = 4$

What will be the price after the merger?

- Equilibrium condition after the merger: $P \approx MC_3 = 5$

<u>*Model validation:*</u> *What are the market shares predicted by the model before the merger?*

Where did we get the information about the marginal costs from?

Merger simulation: Example 3

RBB | Economics

Bertrand competition (homogeneous product, no capacity constraints)

- Before merger: 2 firms, after merger 1 firm
- No efficiencies due to the merger
- Price observed before the merger: $P = 5$
- Equilibrium condition (before the merger): $P = MC$
- Marginal Cost $MC = 5$
- After the merger: Monopoly equilibrium (profit-maximising) condition is: $P = \frac{\varepsilon}{\varepsilon+1} MC$
- Suppose we know that the elasticity is equal to $\varepsilon = -2$
- Predicted price after the merger: $P = 2 * MC = 10$

<u>Model validation:</u> How can we obtain the value of the elasticity of demand?

Caveats

Merger simulation models are static and, like all theoretical models, abstract from several important real-world factors

- What about, for example, future entry/expansion? The possibility of some of the buyers to switch to in-house production?
- What if the market is characterized by high levels of innovation, the success of which is uncertain?

Merger assessment is based both on qualitative and quantitative evidence

- Interviews of customers, competitors, suppliers; internal documents; market reports; market shares; concentration indices; diversion ratios; bidding analysis; investigation of past market entry…
- **Merger simulation model is just one potential piece of evidence:** A merger assessment can never be based on the results of a merger simulation model alone! Moreover, the results from a merger simulation model should be consistent with the other evidence!

Example of a merger simulation model: Bertrand-Edgeworth

Bertrand-Edgeworth model: A primer

RBB | Economics

Bertrand (1883): Firms producing homogeneous products compete in prices

- Each firm has an incentive to slightly undercut rivals as long as the price charged by rivals exceeds its marginal cost
- The price effect of the undercutting is generally small whereas the volume effect is large
- The only equilibrium price (Nash) is one where all firms price at marginal cost

Bertrand paradox: Two competitors suffice to ensure a competitive outcome

In a symmetric duopoly, equilibrium price is equal to the marginal cost. When marginal costs are asymmetric, equilibrium price can be thought to be to the 2^{nd} lowest marginal cost (and the most efficient firm makes profit)

Solutions to the Bertrand paradox

Multiple "solutions" to the Bertrand paradox have been proposed:

- Product differentiation
- Market frictions (search costs, switching costs)
- Capacity constraints

"The correct solution" depends on the actual market characteristics, and sometimes there may be more than one "solution" that fits!

Edgeworth's solution to the Bertrand paradox (1/2)

RBB | Economics

Edgeworth (1897) "solved" the Bertrand paradox by introducing capacity constraints

➔ **"Bertrand-Edgeworth" (BE) framework**

<u>Impacts of capacity constraints on incentives to undercut:</u>

- The volume effect of own price cutting is limited (bounded) by firm's own capacity
- If the capacity of the rivals is not enough to cover the entire market demand, a firm is left with "residual demand" over which it maximizes profits accordingly, i.e. it acts as a 'monopolist' w.r.t. that residual demand (instead of undercutting rivals' prices)
- In equilibrium all firms consider these trade-offs simultaneously

Edgeworth's solution to the Bertrand paradox (2/2)

However:

- If the capacities are small, competition is ineffective potentially to the point where each firm could charge the monopoly price
- If the capacities are large (non-binding capacity constraints), Bertrand paradox prevails

Conclusion:

- If rival firms face capacity constraints and cannot serve the entire market, the remaining firm has some degree of market power
- **In markets with capacity constraints, price can exceed marginal costs and firms can make positive profits**
- As capacity in the hands of rivals decreases, the demand over which the remaining firm can exercise market power increases.

  ➔ Mergers that reduce capacity held by rivals will lead to price increases

BE and Cournot model

RBB Economics

Kreps and Scheinkman (1983): Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes (2865 citations)

- Two identical firms facing a two-stage competitive situation: First firms invest in capacities, then compete in prices
- Limiting own capacity has strategic value because it is a commitment to be not aggressive in the pricing game
- In order to solve their model Kreps / Scheinkman had to “solve” the BE game for all possible firms’ choices about capacities
- This is not trivial even for a duopoly
- Much of the recent effort in theoretical IO research has been put into generalising their result to more firms
- This implies need to understand the second stage of the game (i.e. BE model) better

BE Cycles: Example 1

Linear demand $Q = 8 - P$

Both firms have a capacity of 7 units and marginal cost of 0

<u>Assumption:</u> Efficient rationing (those with the highest wtp served first)

P1\P2	0	1	2	3	4	5	6	7	8
0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0
1	0, 0	3.5, 3.5	7, 0	7, 0	7, 0	7, 0	7, 0	7, 0	7, 0
2	0, 0	0, 7	6, 6	12, 0	12, 0	12, 0	12, 0	12, 0	12, 0
3	0, 0	0, 7	0, 12	7.5, 7.5	15, 0	15, 0	15, 0	15, 0	15, 0
4	0, 0	0, 7	0, 12	0, 15	8, 8	16, 0	16, 0	16, 0	16, 0
5	0, 0	0, 7	0, 12	0, 15	0, 16	7.5, 7.5	15, 0	15, 0	15, 0
6	0, 0	0, 7	0, 12	0, 15	0, 16	0, 15	6, 6	12, 0	12, 0
7	0, 0	0, 7	0, 12	0, 15	0, 16	0, 15	0, 12	3.5, 3.5	7, 0
8	0, 0	0, 7	0, 12	0, 15	0, 16	0, 15	0, 12	0, 7	0, 0

BE Cycles: Example 2

Linear demand $Q = 8 - P$

Both firms have a capacity of 5 units and marginal cost of 0

<u>Assumption:</u> Efficient rationing (those with the highest wtp served first)

P1\P2	0	1	2	3	4	5	6	7	8
0	0, 0	0, 2	0, 2	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0
1	2, 0	3.5, 3.5	5, 2	5, 0	5, 0	5, 0	5, 0	5, 0	5, 0
2	2, 0	2, 5	6, 6	10, 0	10, 0	10, 0	10, 0	10, 0	10, 0
3	0, 0	0, 5	0, 10	7.5, 7.5	15, 0	15, 0	15, 0	15, 0	15, 0
4	0, 0	0, 5	0, 10	0, 15	8, 8	16, 0	16, 0	16, 0	16, 0
5	0, 0	0, 5	0, 10	0, 15	0, 16	7.5, 7.5	15, 0	15, 0	15, 0
6	0, 0	0, 5	0, 10	0, 15	0, 16	0, 15	6, 6	12, 0	12, 0
7	0, 0	0, 5	0, 10	0, 15	0, 16	0, 15	0, 12	3.5, 3.5	7, 0
8	0, 0	0, 5	0, 10	0, 15	0, 16	0, 15	0, 12	0, 7	0, 0

BE Cycles: Example 3a

RBB Economics

Linear demand $Q = 8 - P$

Both firms have a capacity of 4 units and marginal cost of 0

<u>Assumption:</u> Efficient rationing (those with the highest wtp served first)

P1\P2	0	1	2	3	4	5	6	7	8
0	0, 0	0, 3	0, 4	0, 3	0, 0	0, 0	0, 0	0, 0	0, 0
1	3, 0	3.5, 3.5	4, 4	4, 3	4, 0	4, 0	4, 0	4, 0	4, 0
2	4, 0	4, 4	6, 6	8, 3	8, 0	8, 0	8, 0	8, 0	8, 0
3	3, 0	3, 4	3, 8	7.5, 7.5	12, 0	12, 0	12, 0	12, 0	12, 0
4	0, 0	0, 4	0, 8	0, 12	8, 8	16, 0	16, 0	16, 0	16, 0
5	0, 0	0, 4	0, 8	0, 12	0, 16	7.5, 7.5	15, 0	15, 0	15, 0
6	0, 0	0, 4	0, 8	0, 12	0, 16	0, 15	6, 6	12, 0	12, 0
7	0, 0	0, 4	0, 8	0, 12	0, 16	0, 15	0, 12	3.5, 3.5	7, 0
8	0, 0	0, 4	0, 8	0, 12	0, 16	0, 15	0, 12	0, 7	0, 0

BE Cycles: Example 3b

RBB | Economics

Linear demand $Q = 8 - P$, both firms have a capacity of 4 units and marginal cost of 0

P1\P2	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
1	3.50; 3.50	4.00; 3.19	4.00; 3.36	4.00; 3.51	4.00; 3.64	4.00; 3.75	4.00; 3.84	4.00; 3.91	4.00; 3.96	4.00; 3.99	4.00; 4.00
1.1	3.19; 4.00	3.80; 3.80	$\boxed{4.40; 3.36}$	4.40; 3.51	4.40; 3.64	4.40; 3.75	4.40; 3.84	4.40; 3.91	4.40; 3.96	4.40; 3.99	$\boxed{4.40; 4.00}$
1.2	3.36; 4.00	3.36; 4.40	4.08; 4.08	4.80; 3.51	4.80; 3.64	4.80; 3.75	4.80; 3.84	4.80; 3.91	4.80; 3.96	4.80; 3.99	4.80; 4.00
1.3	3.51; 4.00	3.51; 4.40	$\boxed{3.51; 4.80}$	4.36; 4.36	$\boxed{5.20; 3.64}$	5.20; 3.75	5.20; 3.84	5.20; 3.91	5.20; 3.96	5.20; 3.99	5.20; 4.00
1.4	3.64; 4.00	3.64; 4.40	3.64; 4.80	3.64; 5.20	4.62; 4.62	5.60; 3.75	5.60; 3.84	5.60; 3.91	5.60; 3.96	5.60; 3.99	5.60; 4.00
1.5	3.75; 4.00	3.75; 4.40	3.75; 4.80	3.75; 5.20	$\boxed{3.75; 5.60}$	4.88; 4.88	$\boxed{6.00; 3.84}$	6.00; 3.91	6.00; 3.96	6.00; 3.99	6.00; 4.00
1.6	3.84; 4.00	3.84; 4.40	3.84; 4.80	3.84; 5.20	3.84; 5.60	3.84; 6.00	5.12; 5.12	6.40; 3.91	6.40; 3.96	6.40; 3.99	6.40; 4.00
1.7	3.91; 4.00	3.91; 4.40	3.91; 4.80	3.91; 5.20	3.91; 5.60	3.91; 6.00	$\boxed{3.91; 6.40}$	5.36; 5.36	$\boxed{6.80; 3.96}$	6.80; 3.99	6.80; 4.00
1.8	3.96; 4.00	3.96; 4.40	3.96; 4.80	3.96; 5.20	3.96; 5.60	3.96; 6.00	3.96; 6.40	3.96; 6.80	5.58; 5.58	7.20; 3.99	7.20; 4.00
1.9	3.99; 4.00	3.99; 4.40	3.99; 4.80	3.99; 5.20	3.99; 5.60	3.99; 6.00	3.99; 6.40	3.99; 6.80	$\boxed{3.99; 7.20}$	5.80; 5.80	$\boxed{7.60; 4.00}$
2	4.00; 4.00	4.00; 4.40	4.00; 4.80	4.00; 5.20	4.00; 5.60	4.00; 6.00	4.00; 6.40	4.00; 6.80	4.00; 7.20	4.00; 7.60	$\boxed{6.00; 6.00}$

With a more finer price grid a BE cycle appears

Bertrand-Edgeworth Cycles: Conclusion

RBB | Economics

Maskin & Tirole, *Econometrica* 1988

The high point of the BE cycle is the monopoly price from selling to the residual demand leftover after low-price firms have sold their capacity

- Unless demand is perfectly inelastic or proportional rationing is used, this price is not equal to the unconstrained monopoly price

The BE cycles do not reflect an equilibrium behaviour (pure equilibrium strategies do not exist!), but rather (dynamic) best responses in the BE model

- The price path in the BE cycle exhibits the “rockets and feathers” pattern (i.e. sudden substantial increases and slow gradual declines)

Solution concept: The set of rationalizable strategies

RBB Economics

Finite strategic games: the set of prices that survives the iterated elimination of strictly dominated actions is the set of rationalizable prices (that can be played at the cycle)

P1\P2	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1
0.9													
1		3.50; 3.50	4.00; 3.19	4.00; 3.36	4.00; 3.51	4.00; 3.64	4.00; 3.75	4.00; 3.84	4.00; 3.91	4.00; 3.96	4.00; 3.99	4.00; 4.00	
1.1		3.19; 4.00	3.80; 3.80	4.40; 3.36	4.40; 3.51	4.40; 3.64	4.40; 3.75	4.40; 3.84	4.40; 3.91	4.40; 3.96	4.40; 3.99	4.40; 4.00	
1.2		3.36; 4.00	3.36; 4.40	4.08; 4.08	4.80; 3.51	4.80; 3.64	4.80; 3.75	4.80; 3.84	4.80; 3.91	4.80; 3.96	4.80; 3.99	4.80; 4.00	
1.3		3.51; 4.00	3.51; 4.40	3.51; 4.80	4.36; 4.36	5.20; 3.64	5.20; 3.75	5.20; 3.84	5.20; 3.91	5.20; 3.96	5.20; 3.99	5.20; 4.00	
1.4		3.64; 4.00	3.64; 4.40	3.64; 4.80	3.64; 5.20	4.62; 4.62	5.60; 3.75	5.60; 3.84	5.60; 3.91	5.60; 3.96	5.60; 3.99	5.60; 4.00	
1.5		3.75; 4.00	3.75; 4.40	3.75; 4.80	3.75; 5.20	3.75; 5.60	4.88; 4.88	6.00; 3.84	6.00; 3.91	6.00; 3.96	6.00; 3.99	6.00; 4.00	
1.6		3.84; 4.00	3.84; 4.40	3.84; 4.80	3.84; 5.20	3.84; 5.60	3.84; 6.00	5.12; 5.12	6.40; 3.91	6.40; 3.96	6.40; 3.99	6.40; 4.00	
1.7		3.91; 4.00	3.91; 4.40	3.91; 4.80	3.91; 5.20	3.91; 5.60	3.91; 6.00	3.91; 6.40	5.36; 5.36	6.80; 3.96	6.80; 3.99	6.80; 4.00	
1.8		3.96; 4.00	3.96; 4.40	3.96; 4.80	3.96; 5.20	3.96; 5.60	3.96; 6.00	3.96; 6.40	3.96; 6.80	5.58; 5.58	7.20; 3.99	7.20; 4.00	
1.9		3.99; 4.00	3.99; 4.40	3.99; 4.80	3.99; 5.20	3.99; 5.60	3.99; 6.00	3.99; 6.40	3.99; 6.80	3.99; 7.20	5.80; 5.80	7.60; 4.00	
2		4.00; 4.00	4.00; 4.40	4.00; 4.80	4.00; 5.20	4.00; 5.60	4.00; 6.00	4.00; 6.40	4.00; 6.80	4.00; 7.20	4.00; 7.60	6.00; 6.00	
2.1													

Determining maximum and minimum of the set of rationalizable prices analytically

RBB | Economics

Above, price has been a discrete variable. Typically, however, price is continuous.

➔ Outcome of the BE model (the set of rationalizable prices) is an interval $[\boldsymbol{p}^{\boldsymbol{min}}, \boldsymbol{p}^{\boldsymbol{max}}]$.

The upper bound price, $\boldsymbol{p}^{\boldsymbol{max}}$, is always determined by the firm with the largest capacity (the capacity leader)

- The upper bound price equals the monopoly price that the capacity leader sets given the residual demand that is left when all the rivals produce at full capacity.

The lower bound price, $\boldsymbol{p}^{\boldsymbol{min}}$, is typically also determined by the capacity leader, unless the marginal cost of the capacity leader is significantly higher than the marginal costs of the other firms. (Not typical due to economies of scale.)

- The lower bound is determined by an indifference condition: The profits of a firm at the lower and at the upper bound must equal.

Example: Determining maximum and minimum of the set of rationalizable prices analytically

Linear demand $Q = 8 - P$, **Firm 1** has a capacity of **6** units and **Firm 2** has a capacity of **4** units. Marginal cost of both firms is 0.

Upper bound price: Residual demand of Firm 1 is $Q_R = 8 - P - 4 = 4 - P$. For this demand, the monopoly price solves the first-order condition:

$$\boldsymbol{\frac{\partial}{\partial P}[(4 - P)P] = 0 \Leftrightarrow p^{max} = 2}$$

As a result, the profit of **Firm 1** at the upper bound equal $\boldsymbol{\pi^1 = 4}$**.**

Lower bound price: What is the price, $\boldsymbol{p}$, such that if Firm 1 is able to sell its entire capacity at price $\boldsymbol{p}$, then Firm 1 is indifferent between $\boldsymbol{p}$ and $\boldsymbol{p^{max}}$?

$$\boldsymbol{6p = \pi^1 \Leftrightarrow p^{min} = \frac{4}{6} = \frac{2}{3}}$$

That is, the set of rationalizable prices is $\left[\frac{2}{3}, 2\right]$.

Observations from the analytical solution

RBB | Economics

The larger the capacity of the rivals, the smaller the residual demand faced by the capacity leader

➔ **The smaller the upper bound price** p^{max}

The larger the capacity of the capacity leader, the lower the leader has to push the price in order to sell her entire capacity

➔ **The smaller the lower bound price** p^{min}

A merger, where the merged entity will be the post-merger capacity leader, will lead to an increase in the upper bound price, p^{max}**,** and typically also the lower bound price, p^{min}, provided that the lower bound price is also determined by the capacity leader.

Illustration of the possible effect of the merger on the set of rationalizable prices

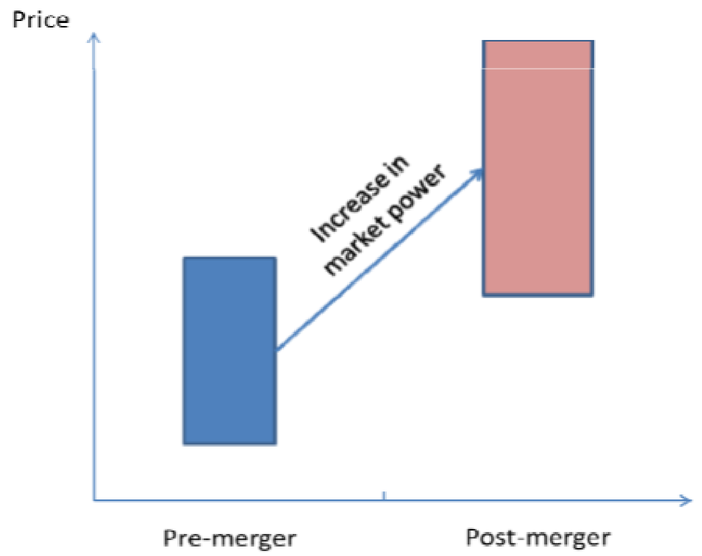
RBB Economics

A merger redistributes capacities, which may lead to a **shift in the range** of rationalizable prices.

The magnitude of the shift depends on:

- The change in the capacity distribution across the firms in the market
- Overall elasticity of demand
- Constraint from imports
- Marginal cost synergies

Illustration of the increase in market power reflected by the change in the range of rationalisable prices



Source: Commission Decision, Case No COMP/M.6471 – Outokumpu/ INOXUM

Pre- and post-merger price ranges often overlap and because the upper bound of the range may increase by more than the lower bound it might be difficult to evaluate the 'true' effect of the merger on price.

BE model: Conclusions

RBB Economics

- No single equilibrium price but **a range of prices** that can be observed in the equilibrium
- The capacity leader determines the upper and lower bounds of the price range:
  - **Upper bound:** Maximization of the monopoly profit (given the residual demand)
  - **Lower bound:** Profit indifference condition of the capacity leader
- A merger where the merged entity will be the **post-merger capacity leader** will **always** lead to an **upward shift in the range of rationalizable prices**
- A merger between second and third largest firms does not lead to changes in upper and lower bound prices, unless their joint capacity exceeds that of the largest firm
- There are (at least) two ways to compute the price range:
  - Numerical, based on the elimination of dominated strategies
  - Analytical ("price formula")

Applications of Bertrand-Edgeworth model

BE & EC: introduction

RBB Economics

EC:

The change in the predicted price range provides a measure of the degree of change in market power resulting from the transaction.

In practice:

EC has computed the percentage change in the midpoints of the supports of the market price distributions and interpreted changes greater than 5%-10% as a sign of significant change in market power.

The main motivation for the EC to use the BE model has been to assess (and reject) the argument of the parties that there cannot be any price effects because rivals have substantial spare capacity.

BE & EC: M.6471 Outokumpu/Inoxum (2012)

RBB | Economics

Model was solved **numerically** using a refinement of strict dominance by Börgers (1992)

- EC used information on **heterogeneous costs**
- Demand parameters (= an estimate for the market demand elasticity) was obtained from the literature
- Assumptions: Linear demand (sensitivity checks with log-linear demand) and efficient rationing
- Calibration: Adjust free parameters such that
  a) Observed pre-merger price falls within the pre-merger price bounds predicted by the model (not successful); and
  b) share of imports pre-merger matches the observed share of imports

“Free” variables: The elasticity of supply of imports and maximum sustainable level of capacity (also the estimates for the elasticity of demand and marginal costs were adjusted in order to get a better fit)

BE & EC: M.6905 Ineos/Solvay (2014)

RBB Economics

The parties brought the model forward in order to assess remedies

- The parties assumed homogeneous costs and given this assumption, the Commission solved the model analytically, using the results from Hirata (2009)
- The parties did not have an estimate for the elasticity of the market demand and proceeded under the assumption of unit elasticity (at the prevailing market price).
- EC then used the model to assess the merger impacts

In connection with this merger assessment, EC also made **an ex-post assessment** of two past mergers Ineos/Kerling (2008) and Ineos/Tessenderlo (2011):

- Clearance based on *inter alia,* on the assumption that competitors' spare capacity (20% of the production capacity in Ineos/Tessenderlo) will act as a sufficient competitive constraint on Ineos.
- According to the results from the ex-post assessment, both Ineos/Kerling (2008) and Ineos/Tessenderlo (2011) led to (significant) price increases.

A final puzzle 1/5 (Let's have fun!)

RBB | Economics

Suppose you are about to assess a merger in an industry with homogeneous goods and capacity constraints.

Suppose the parties have provided you with estimates for the following information:

- marginal cost c;
- market price p;
- total market demand q
- total market capacity K
- pre-merger capacity of the capacity leader K_L^0, denote $K_{-L}^0 = K - K_L^0$
- post-merger capacity of the capacity leader = the merged entity K_L^1, denote $K_{-L}^1 = K - K_L^1$

Suppose there is no market demand elasticity estimate available!

A final puzzle 2/5 (Let's have fun!)

RBB | Economics

What do we know?

- **Inputs:** Marginal cost c; market price p; total market demand q; capacities K, K_L^0, and K_L^1.
- **Equilibrium conditions:** The upper bound price is the monopoly price charged by the capacity leader given that all other firms operate at full capacity. The lower bound is given by the indifference condition.

Goal: To solve the pre-merger equilibrium price range and recover demand parameters so that we can then estimate the post-equilibrium price range.

Key question: What should the demand parameters be in order for the observed price p to fall withing the pre-merger equilibrium price range $[\boldsymbol{p^{min}}, \boldsymbol{p^{max}}]$?

A final puzzle 3/5 (Let's have fun!)

RBB | Economics

Key question: What should the demand parameters be in order for the observed price p to fall withing the pre-merger equilibrium price range $[\boldsymbol{p^{min}}, \boldsymbol{p^{max}}]$?

Can we make some assumptions to make this more tractable?

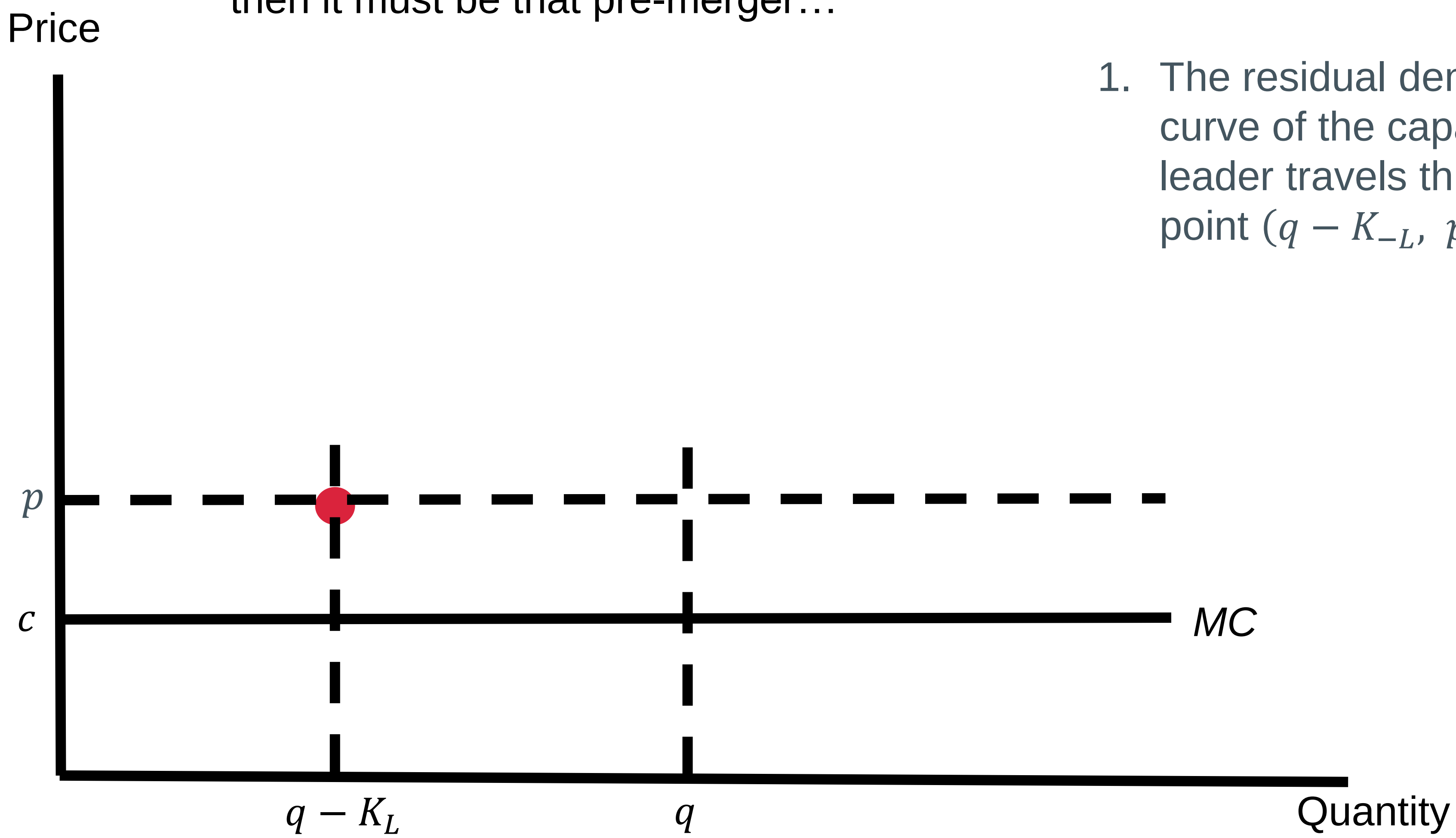
- Linear demand
- Homogeneous marginal costs
- Efficient rationing

What if we assume that the observed market price p is actually the upper bound price p^{max}? Can we get anywhere then?

A final puzzle 4/5 (Let's have fun!)

RBB | Economics

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

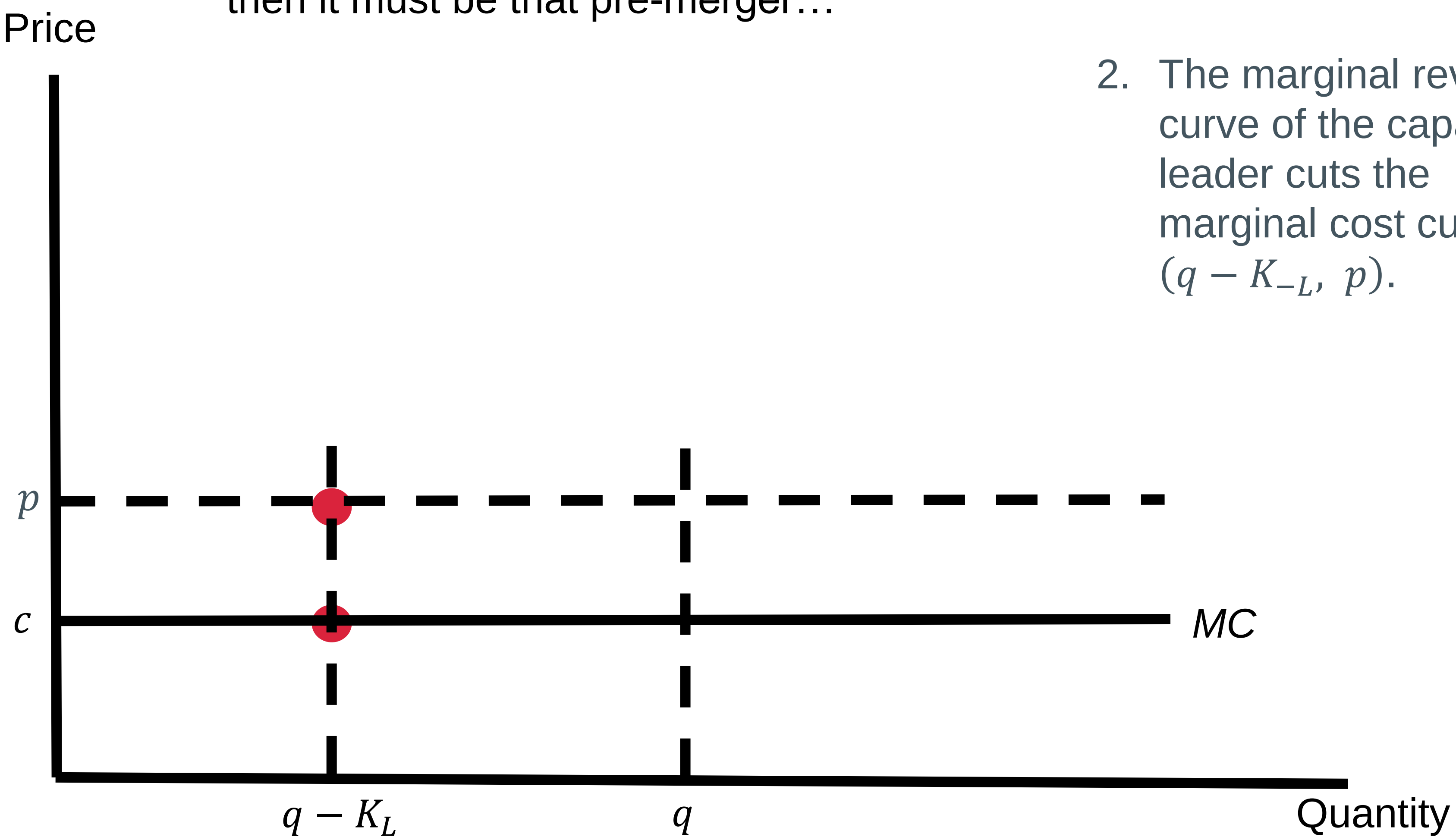


1. The residual demand curve of the capacity leader travels through point $(q - K_{-L},\ p)$.

A final puzzle 4/5 (Let's have fun!)

RBB | Economics

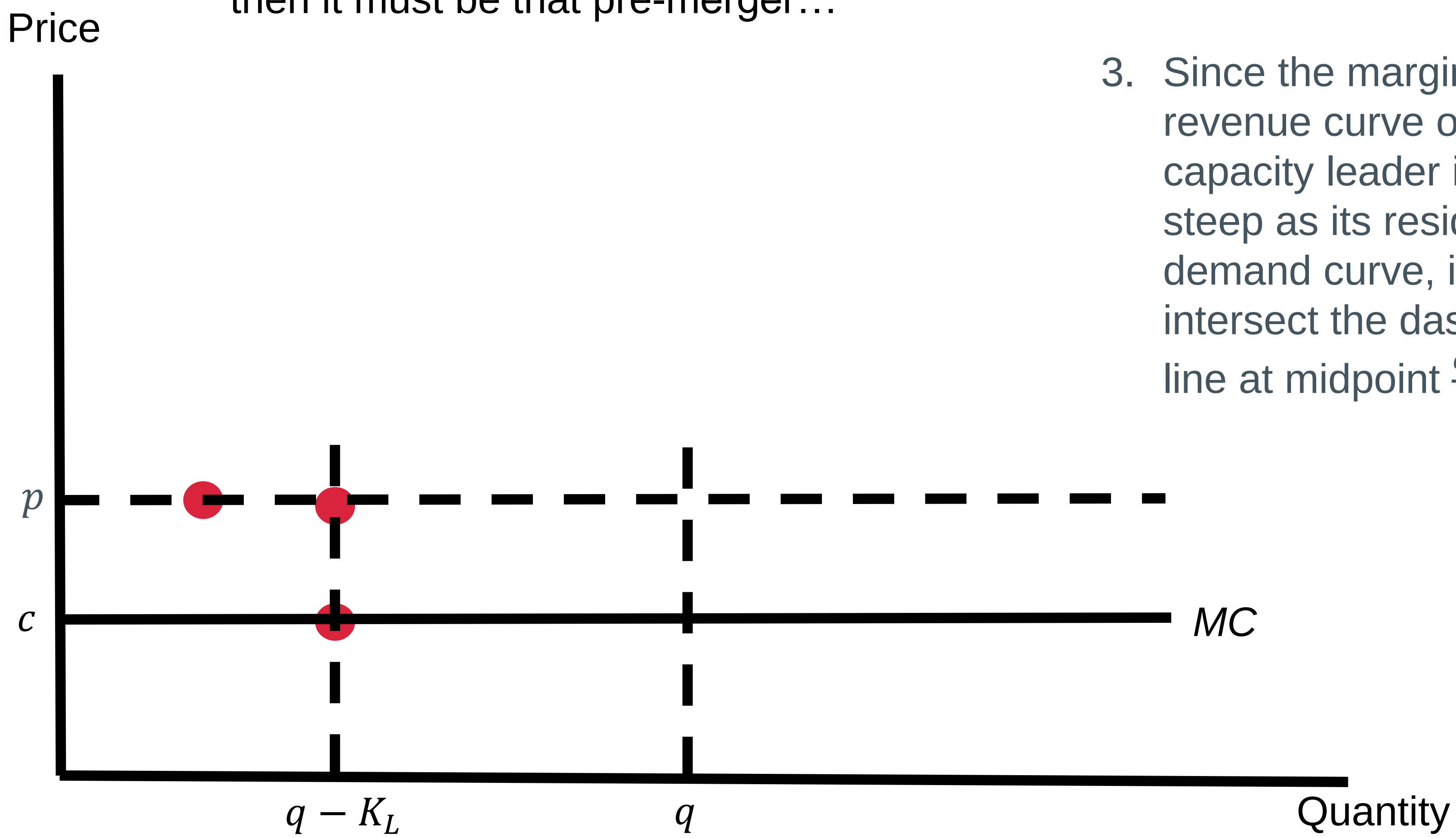
Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…



2. The marginal revenue curve of the capacity leader cuts the marginal cost curve at $(q - K_{-L},\ p)$.

A final puzzle 4/5 (Let’s have fun!)

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…



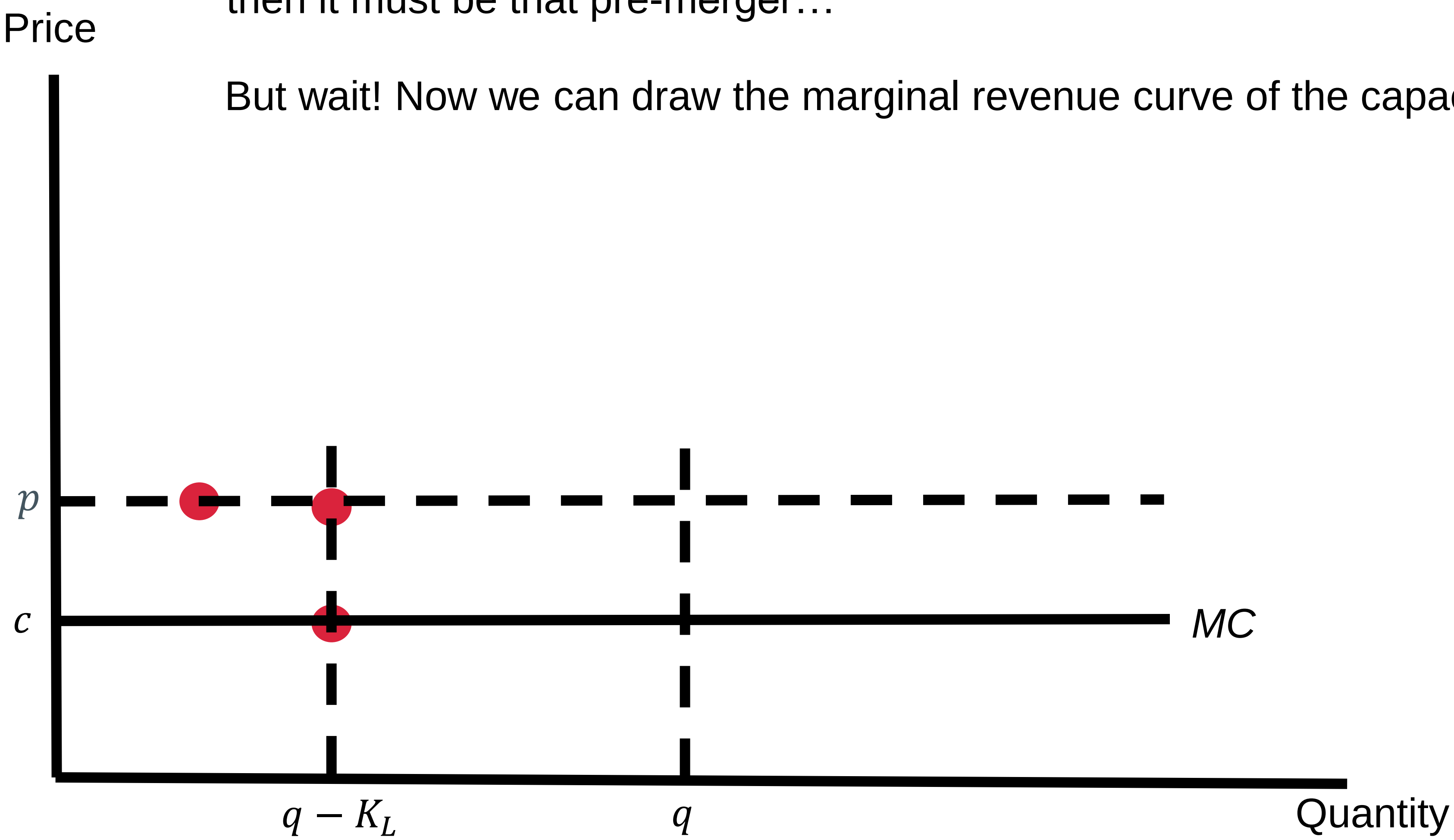
3. Since the marginal revenue curve of the capacity leader is twice as steep as its residual demand curve, it must intersect the dashed price line at midpoint $\frac{q-K_{-L}}{2}$.

A final puzzle 4/5 (Let’s have fun!)

RBB | Economics

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

But wait! Now we can draw the marginal revenue curve of the capacity leader!

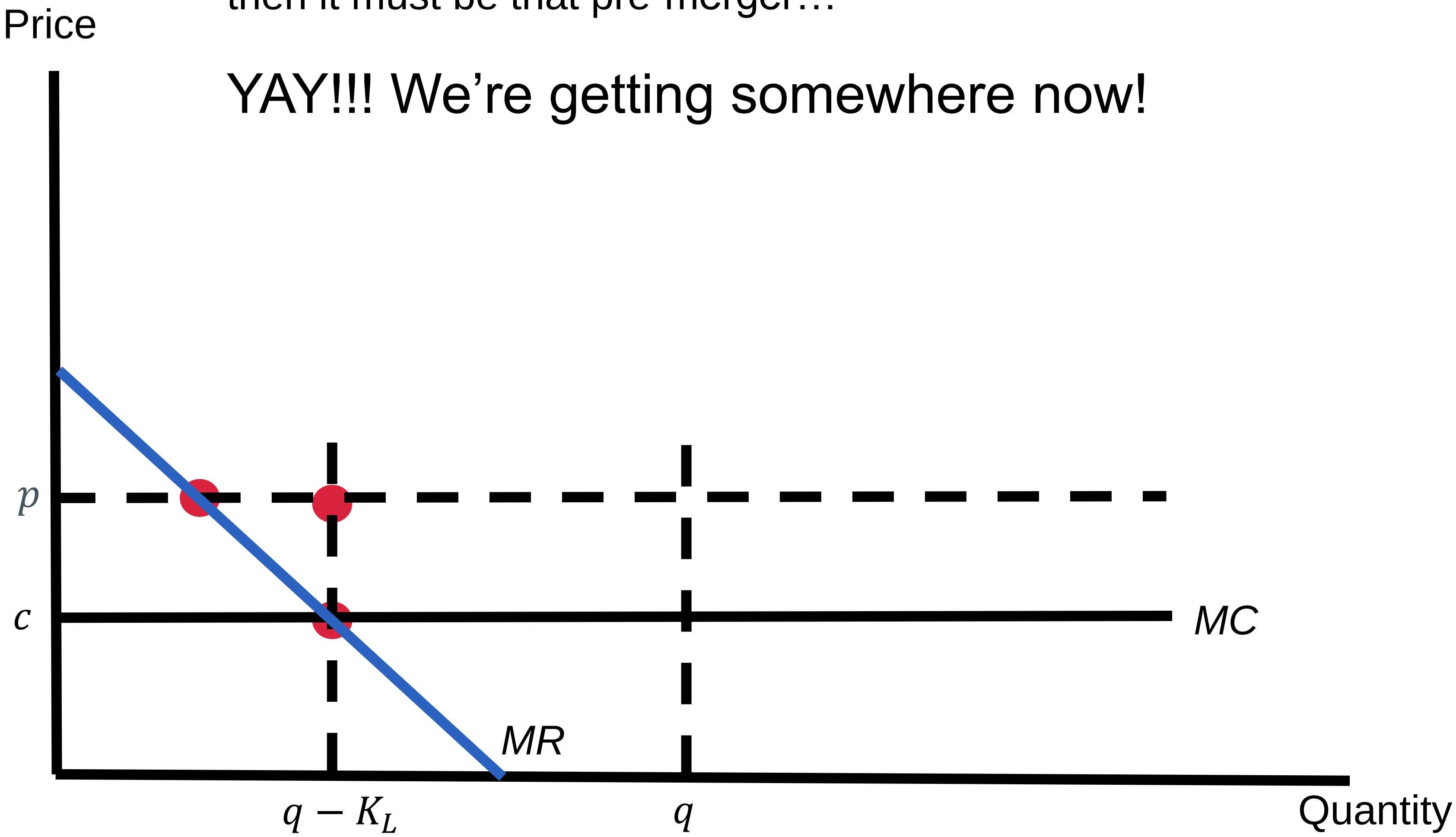


A final puzzle 4/5 (Let's have fun!)

RBB Economics

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

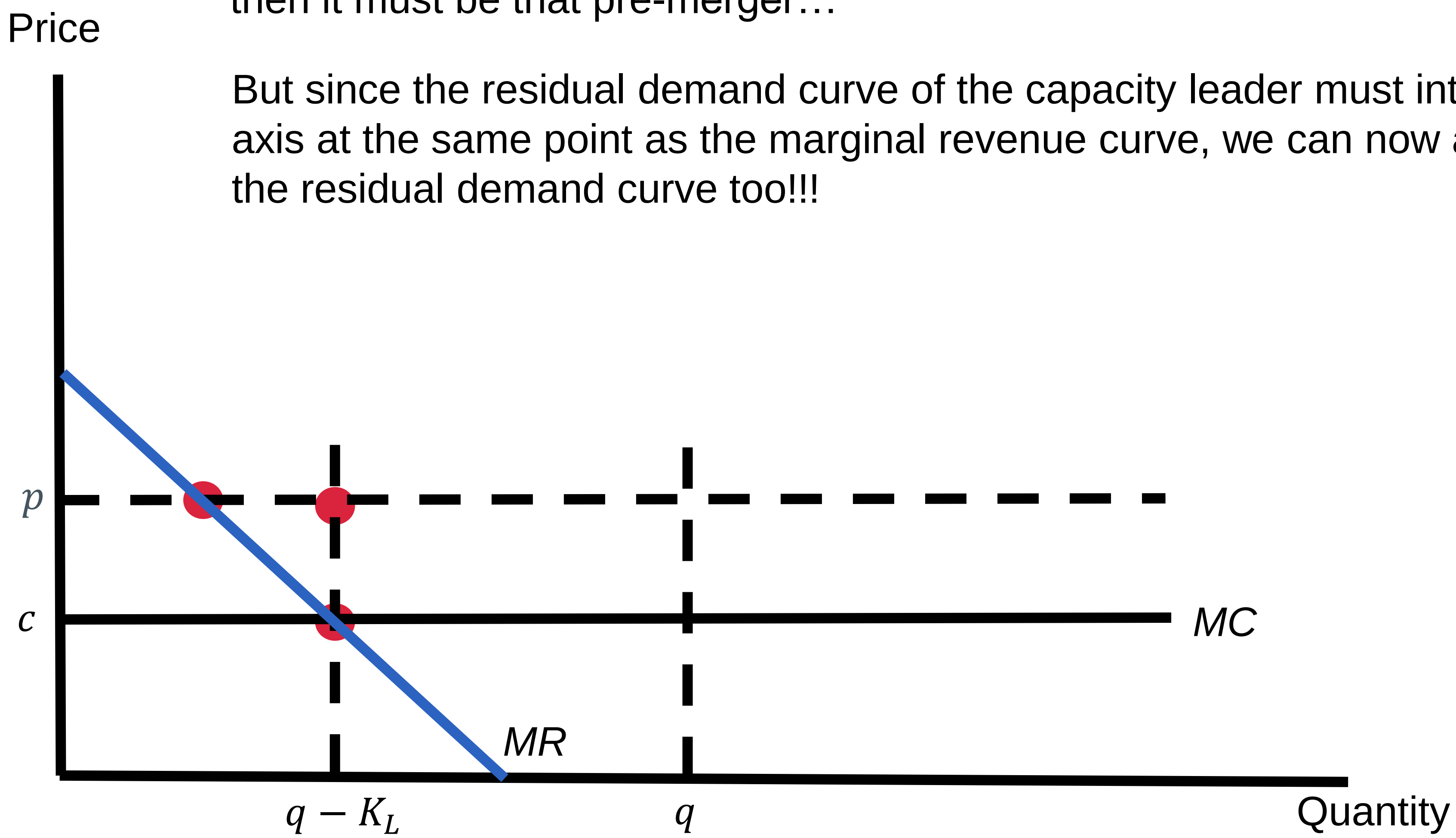
YAY!!! We're getting somewhere now!



A final puzzle 4/5 (Let's have fun!)

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

But since the residual demand curve of the capacity leader must intersect the y-axis at the same point as the marginal revenue curve, we can now actually draw the residual demand curve too!!!

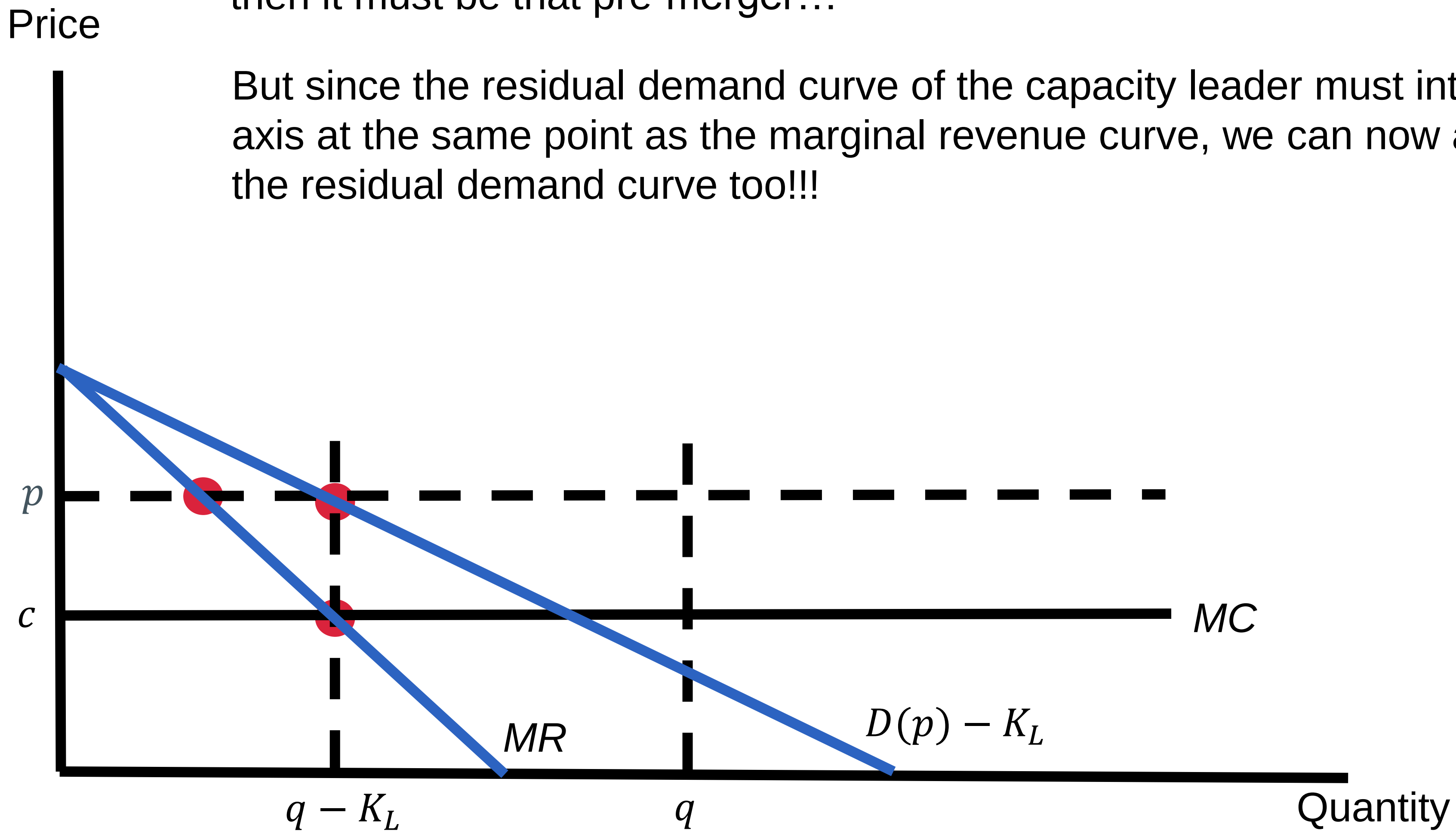


A final puzzle 4/5 (Let's have fun!)

RBB Economics

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

But since the residual demand curve of the capacity leader must intersect the y-axis at the same point as the marginal revenue curve, we can now actually draw the residual demand curve too!!!

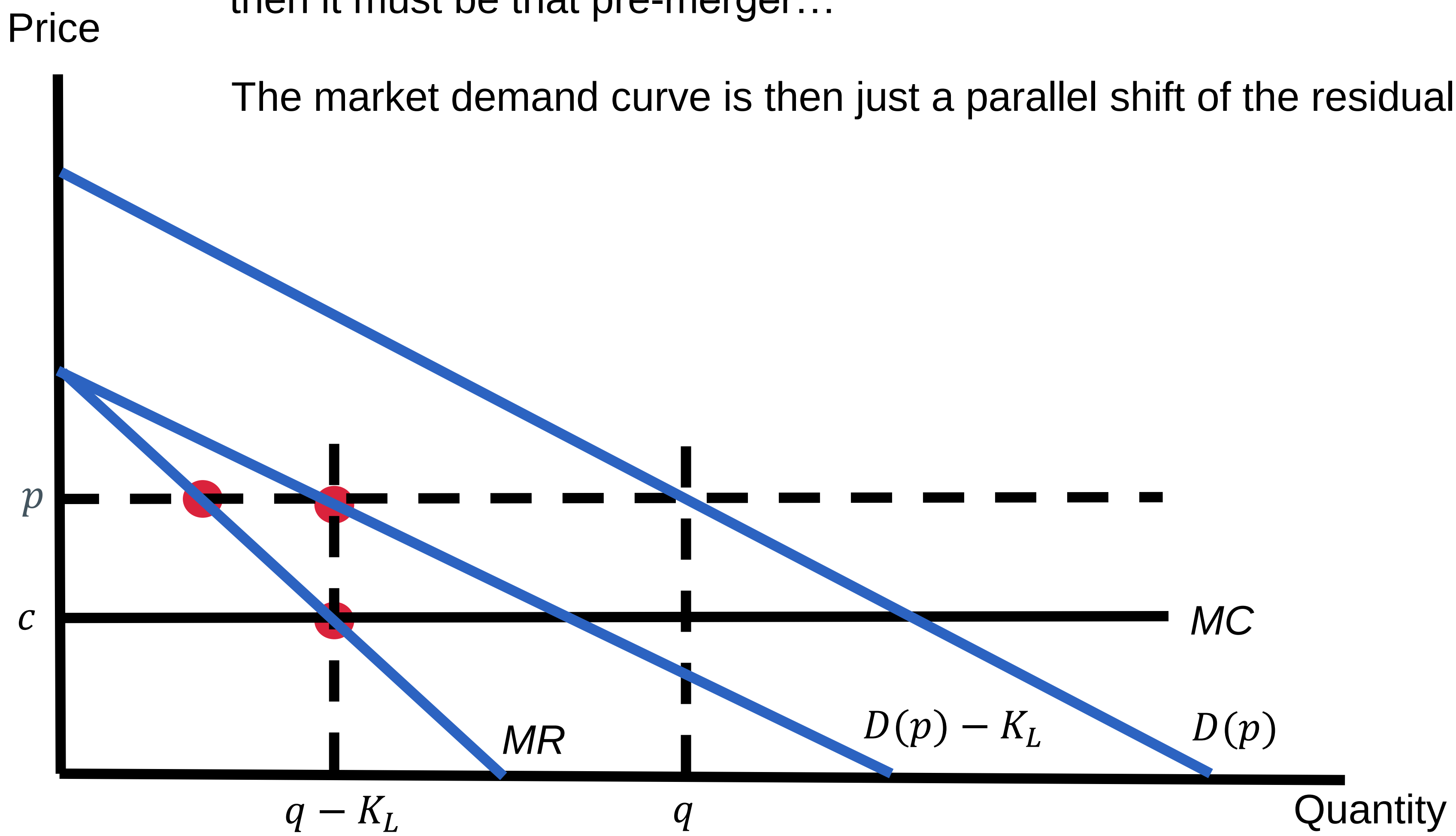


A final puzzle 4/5 (Let’s have fun!)

RBB | Economics

Right, so this is what we know… And we know that if p is the upper bound price, then it must be that pre-merger…

The market demand curve is then just a parallel shift of the residual demand curve!



A final puzzle 5/5 (Let’s have fun!)

RBB | Economics

Now when we know the demand curve, we can compute the pre- and post-merger upper and lower bounds of the equilibrium price ranges!

<u>**Note:**</u> Above we matched the observed market price with the predicted pre-merger upper bound price. This yields the **upper bound estimate for the demand elasticity $\boldsymbol{\varepsilon}$**

$\Longrightarrow$ This implies that the model predicts minimum merger effects. Therefore, this assumption is the most advantageous scenario for the merging parties

Matching the observed price with the predicted pre-merger lower bound price yields the **lower bound estimate for the demand elasticity $\boldsymbol{\varepsilon}$**

$\Longrightarrow$ Maximum merger effects. Therefore, this assumption is the worst-case scenario for the parties

For proofs as well as discussion on the tightness of the upper and lower bound estimates for the demand elasticity, write me an email! (Or perhaps Pauli can make these as homework!)

References

RBB | Economics

Börgers, T. (1992). Iterated Elimination of Dominated Strategies in a Bertrand Edgeworth Model, *Review of Economic Studies*, 59(1), 163–176.

Commission's Decision of 26 July 2011 in Case No. M.6218 INEOS/Tessenderlo Group S PVC Assets

Commission's Decision of 30 January 2008 in Case No. M.4734 INEOS/Kerling

Commission's Decision of 7 November 2012 in Case No. M.6471 Outokumpu/Inoxum

Commission's Decision of 8 May 2014 in Case No. M.6905 INEOS/Solvay/JV

Commission's Decision of 8 May 2014 in Case No. M.6905 INEOS/Solvay/JV, Annex B

Deneckere, R. J ., and D. Kovenock. (1992). Bertrand Edgeworth Duopoly with Unit Cost Asymmetry, *Economic Theory*, 8(1), 1–25.

Hirata, D. (2009) Asymmetric Bertrand Edgeworth Oligopoly and Mergers , *The B.E. Journal of Theoretical Economics*, 9(1) 1), 1–25.

Kreps, D., and J. Scheinkman. (1983). Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes, *Bell Journal of Economics*, 14(2), 326–337

RBB | Economics

Interested working in competition economics?

Send me an email anytime at paula.makela@rbbecon.com

or give me a call +32 493 899 045