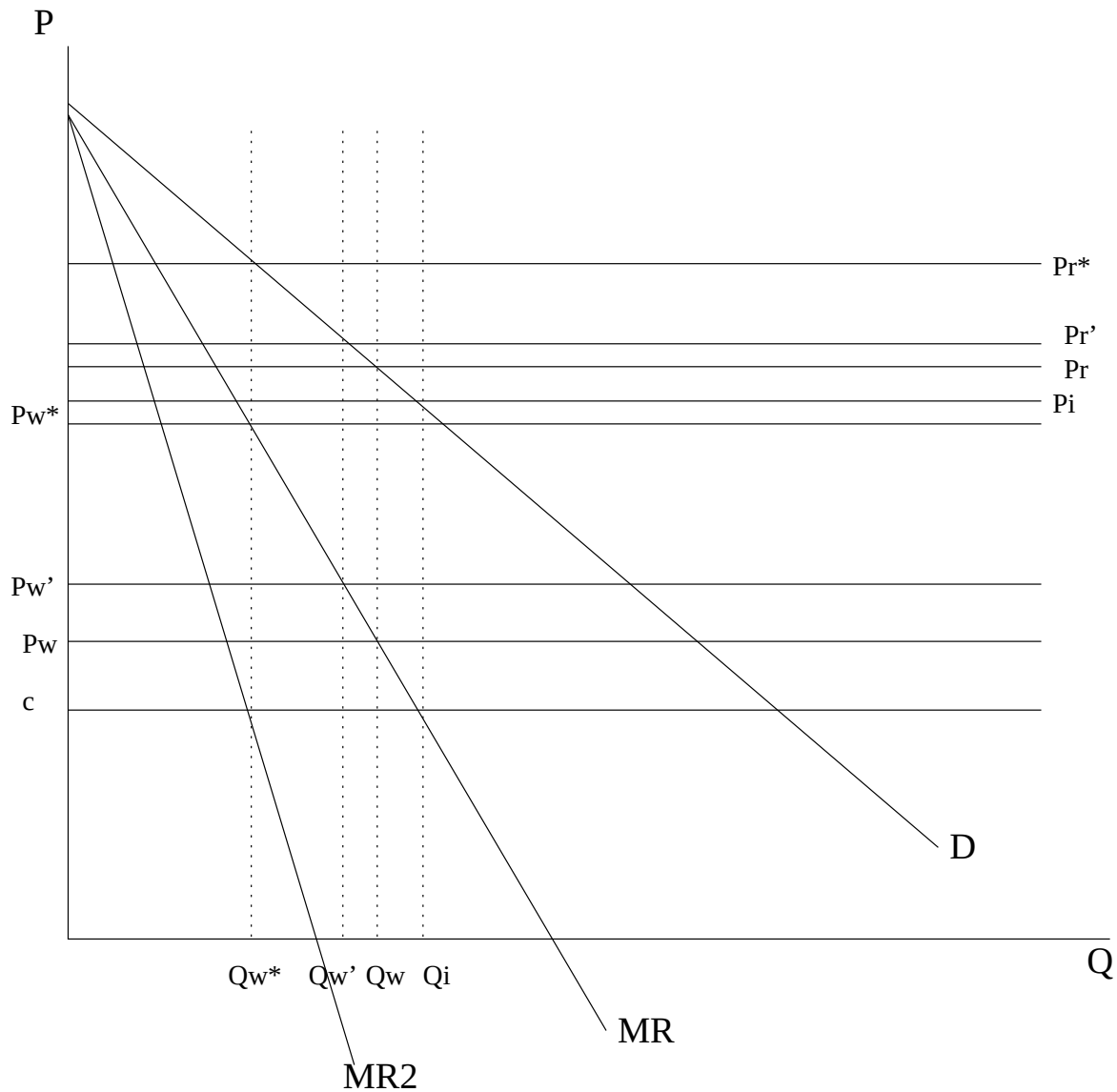
Vertical integration and vertical restraints

- Up to now, consider only firm who produces as well as sells final product
- Most industries characterized by *upstream* vs. *downstream* firms.
- Question: focus on problems in vertical setup, and upstream firm's incentives to either **vertically integrate** or approach the integrated outcome using **vertical restraints**.
- Upstream: produce product. Downstream: retailer/distributor who sells the product
  1. Double marginalization
  2. Free-riding
- Upstream: produce inputs. Downstream: produce and sell final product
  1. Input substitution
  2. Price discrimination
- Don't focus on cost aspects (Stigler)

Double marginalization 1

- Monopolist upstream manufacturer; marginal cost c, chooses wholesale price p_w
- Monopolist downstream retailer; marginal cost is p_w, chooses retail price p_r
- Graph
- Integrated firm: choose p_r so that $MR(q) = c \longrightarrow q_i$
- Nonintegrated outcome: solve backwards
  1. Retailer: sets p_r so that $MR(q) = p_w$. $MR(q)$ is the demand curve faced by manufacturer: **Monopoly retailer restricts output.**
  2. Manufacturer maximizes using retailer's demand curve: lower quantity, higher price relative to integrated firm.
- Total profits lower in non-integrated scenario.



- Integrated monopolist: (Q_i, P_i)

- Nonintegrated: monopolist retailer sets retail price where $P_w = MR$. Thereby, wholesaler faces demand curve of MR.
- Wholesaler optimally sets P_w^* so that $c = MR_2$ (so "double marginalization"): outcome is (P_w^*, P_r^*, Q_w^*)
- Total profits lower in non-integrated scenario.

Double marginalization 2

Example: $Q = 10 - p$; c=2

Integrated firm: q_i=4, p_i=6, π_i=16

Non-integrated scenario (solve backwards):

- Retailer:
  1. Given p_w, $\max_{p_r}\ (p_r - p_w)(10 - p_r)$
  2. FOC: $10 - p_r - (p_r - p_w) = 0 \longrightarrow p_r = \frac{10+p_w}{2}$.
  3. Demand, as a function of p_w: $Q(p_w) = 10 - \frac{10+p_w}{2} = 5 - \frac{p_w}{2}$. This is demand curve faced by manufacturer (and coincides with MR curve of retailer)
- Manufacturer
  1. $\max_{p_w}(p_w - 2)(5 - \frac{p_w}{2})$
  2. FOC: $5 - \frac{p_w+p_w-2}{2} = 0 \longrightarrow p_w = 6$
- $p_w = 6 \longrightarrow p_r$=8, $q_n = 2$. Lower output, higher price.
- $\pi_w = 4$, $\pi_r = 8$. Lower total profits.
- Lower total profits is incentive to integrate. What else can mftr. do?

Double marginalization 3

- Main problem is that monopoly retailer sets $p_r > p_w$. How can this be overcome?
  - **Resale price maintenance (RPM)**
    Price ceiling: $p_r = p_w$. Illegal?
  - Quantity forcing: force retailer to buy $q = q_i$ units (sales quotas)
  - General: increase competition at retail level. With PC retail market, $p_r = p_w$ and problem disappears.
- Alternatively, set $p_w = c$ and let retailer set p_r so that $MR(q) = c = p_w$. Then recoup integrated profits π_i by **franchise fee**. Only works if franchise market is competitive.

Free-riding in retail sector 1: "downstream moral hazard"

DM arises since retail sector is not competitive. Now consider problems which arise if retail sector is competitive.

Assume monopolist mftr. and retail sector with two firms competing in Bertrand fashion.

Demand function $Q(p, s)$, depending on price p and retail services (advertising) s.

Problem: Assume demand goes up if *either* firm advertises. One firm has no incentive to advertise if other firm does: **free-riding**.

Examples: in-store appearances, online perfume discounters

Solve the game backwards:

- Bertrand competition: zero profits no matter what. Neither firm advertises $\longrightarrow$ low demand.
- Mftr. faces lower demand and lower profits.

Free-riding in retail sector 2

Main problem: under Bertrand competition, retail profits don't depend on whether or not there is advertising. Correct problem by tying retailer profits to their advertising activities: general principle of the **residual claimant.**

1. **Exclusive territories**: grant retailers monopoly in selling manufacturer's product. Now retailer's profits increase if it advertises, but run into DM problem. Explain make-specific new car dealerships?
2. Limit number of distributors (same idea)
3. Resale price maintenance: set *price floor* $\underline{p} > p_w$. Again, this ties retailers' profits to whether or not they advertise.

Free-riding at manufacturer level: If there is upstream competition, one mftr's efforts to (say) improve product image can benefit all manufacturers $\longrightarrow$ **exclusive dealing**: forbid retailer from selling a competing manufacturer's product.

Input substitution 1

Now consider the case where upstream firm produces an input that is used by downstream firms in producing final good. Focus on case when upstream firm prefers to integrate.

Main ideas: Monopoly pricing for one of the inputs shifts downstream demand for input away from it.

Can lead to socially inefficient use of an input.

By integrating with DS industry, monopolist increases demand for its input (and perhaps profits).

Occurs no matter if downstream industry is competitive or not.

Input substitution 2

Example (diagram):

- Market demand for final good: $p = 10 - q$
- Two inputs:
  1. Competitive labor market, wage $w = 1$
  2. Energy E produced by an upstream monopolist. Monopolist produces with marginal cost $m = 1$ and sells it at price e.
- Final good produced from a production function $q = E^{1/2}L^{1/2}$.
- Competitive downstream industry: final good is sold at $p = MC(q)$.
- Analyze 3 things (C/P pp. 551-552; see handout):
  1. Calculate $MC(q)$ function for DS industry
  2. Integrated outcome
  3. Non-integrated outcome

Input substitution 3

Calculating DS marginal costs

First solve for DS firm cost function $C(w, e, Q)$: given input prices w and e, what is minimal cost required to produce output Q?

- DS firms combine E and L to produce a given level of output Q at the lowest possible cost:

$$C(e, w, Q) = \min_{E,L} eE + wL \text{ s.t. } Q = E^{1/2}L^{1/2}$$

  given input prices e, w, and output level Q.

- Substituting in the constraint:

$$C(e, w, Q) = \min_{E} eE + w\left(\frac{wQ^2}{E}\right)$$

- FOC: $E = Q\left(\frac{w}{e}\right)^{1/2}$, and $L = Q\left(\frac{e}{w}\right)^{1/2}$. Substitute back into cost function.
- $C(e, w, Q) = 2Q(we)^{1/2}$. Marginal cost $= \frac{\partial C}{\partial Q} =$

$$MC(e, w, Q) = 2(we)^{1/2}.$$

Input Substitution 4

Integrated firm: Monopoly also controls DS industry

- In integrated firm, set $e = m = 1$, so that $MC = 2$.
- $\max_p (p-2)q = (p-2)(10-p)$.
- $p_i = 6$, $q_i = 4$. $E_i = L_i = 4$.
- $\pi_i = (6-2) * 4 = 16$.

Non-integrated scenario

- DS: Chooses quantity q so that $p = MC \Leftrightarrow p = 10 - q = 2(we)^{1/2} \Longrightarrow q = 10 - 2(we)^{1/2}$
- Given this q, demand for E is:

$$E = \frac{a\left(\frac{w}{e}\right)^{1/2} - 2w}{b}.$$

At $a = 10$, $b = 1$: $E = 10\left(\frac{1}{e}\right)^{1/2} - 2$

- US: $\max_e (e-1) * E = (e-1) * \left[10\left(\frac{1}{e}\right)^{1/2} - 2\right]$
- FOC (complicated!): $5e - 2e^{3/2} + 5 = 0$
- $e_u = 7.9265$. $MC = 5.6308 = p_u$. $q_u = 4.3692$.
- $\pi_u^{US} = 10.75$, $\pi_u^{DS} = 0$ (DS is competitive).
- Story holds only if two input are *substitutes*. cf. C/P ("fixed-proportions" case)

Vertical integration for price discriminate 1

Main idea: 3rd-degree price discrimination may be impossible due to resale opportunities. Incentive for monopolist to integrate with constomer with more elastic demand. This allows it to raise price to constomer with less elastic demand, without worrying about resale.

Re-examine 3DPD example from last lecture:

- Consider two customers, with demand functions

$$\begin{aligned} 1\text{:}\ & q_1 = 5 - p \\ 2\text{:}\ & q_2 = 5 - 2 * p \end{aligned}$$

  Graph. Think of:

  1. US: aluminum producer
  2. Group 1: airplane producer
  3. Group 2: wire producer (alternatives for aluminum readily available)

- Monopolist produces at zero costs

Vertical integration to price discrimination 2

Without price-discrimination (from last class):

- $\max_p \pi^m = p * (5 + 5 - (1 + 2) * p) = p * (10 - 3p)$
- $$\begin{aligned} p_1^M &= \frac{5}{3} & p_2^M &= \frac{5}{3} \\ q_1^M &= \frac{10}{3} & q_2^M &= \frac{5}{3} \\ \pi_1^M &= \frac{50}{9} & \pi_2^M &= \frac{25}{9} \end{aligned}$$

Vertical integration to price discriminate 3

Now assume it integrates with customer 2 (wire producer): becomes a multiproduct firm which produces raw aluminum as well as aluminum wire.

Now it charges the monopoly aluminum price to customer 1 (airplane producer):

- $\max_p \pi^m = p * (5 - p) \longrightarrow p^m = \frac{5}{2} > \frac{5}{3}$
- $q_1 = \frac{5}{2}$, $\pi_1 = \frac{25}{4}$.

Counterintuitive: aluminum mftr merges with business which is relative "unspecialized" in its product. Cost savings could dictate why aluminum mftr could merge with airplane maker.

Sum-Up

- Inefficiencies in vertical relationship
  1. double marginalization: DS monopoly contracts output too much
  2. Free-riding (DS moral hazard): DS competition provides too few retail services
- Reasons for vertical integration
  1. Input substitution: too little of monopoly input is used
  2. Price discrimination: VI enables PD.