2.2 — Bertrand Competition

ECON 316 • Game Theory • Fall 2021

Ryan Safner

Assistant Professor of Economics

safner@hood.edu

ryansafner/gameF21

gameF21.classes.ryansafner.com

A More Rigorous Oligopoly/Cartel Problem

Example: Suppose Squeaky Clean (Firm 1) and Biobase (Firm 2) are the only two producers of chlorine for swimming pools. The inverse market demand for chlorine is

$$P = 32 - 2Q$$

where $Q = q_1 + q_2$ is measured in tons, and P is \$/ton. Assume only a constant marginal cost of \$16 for both firms

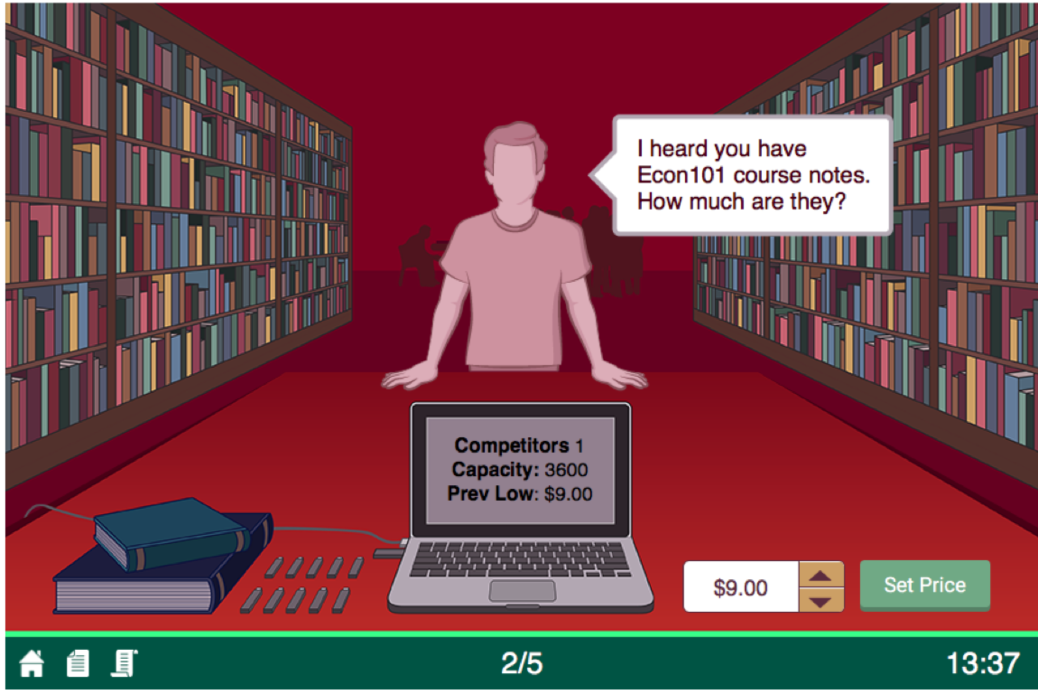
1. If the two firms collude and agree to act as a monopolist and evenly split the market, how much will each firm produce, what will be the market price, and how much profit will each firm earn?

2. Under this agreement, does either firm have an incentive to cheat (i.e. by producing an additional ton of chlorine)? What would happen to each firm's profits if either, or both, cheated?

Bertrand Competition: Moblab

Bertrand Competition: Moblab

- Each of you are selling identical Economics 101 course notes
- You will be randomly put into a market with 1 other player
- Each term, both of you simultaneously choose your price
- Seller(s) choosing the lowest price get **all** the customers

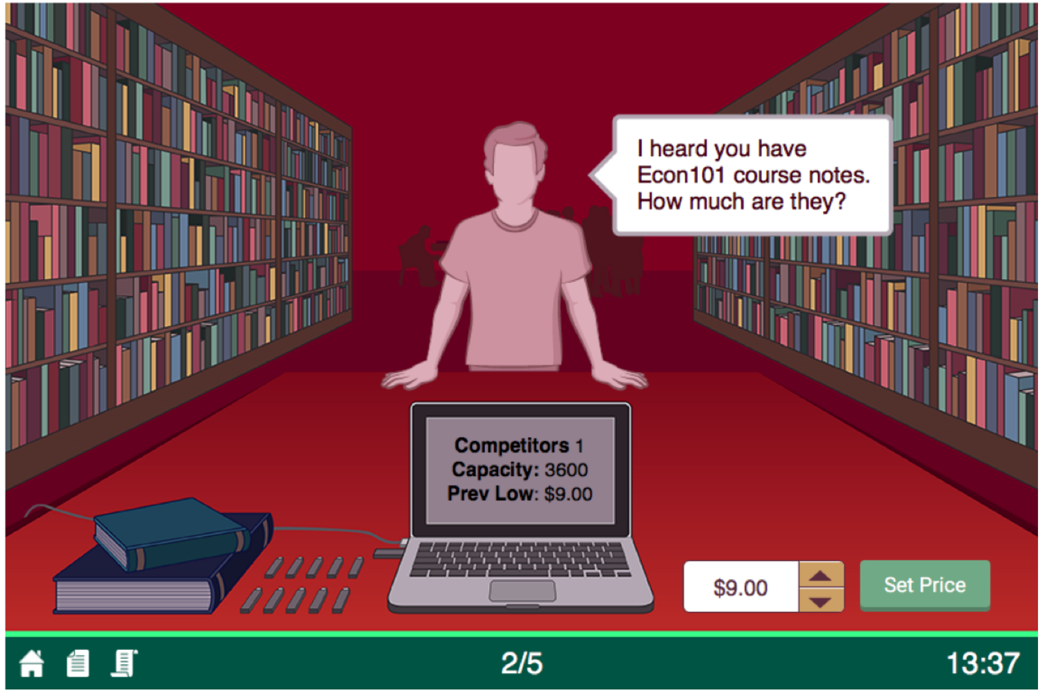


Bertrand Competition: Moblab

- The lowest price p_L determines the market demand

$$q = 3600 - 200p_L$$

- Both firms have \$2 cost per unit sold
- $p = 10$ maximizes total market profits



Bertrand Competition: Moblab

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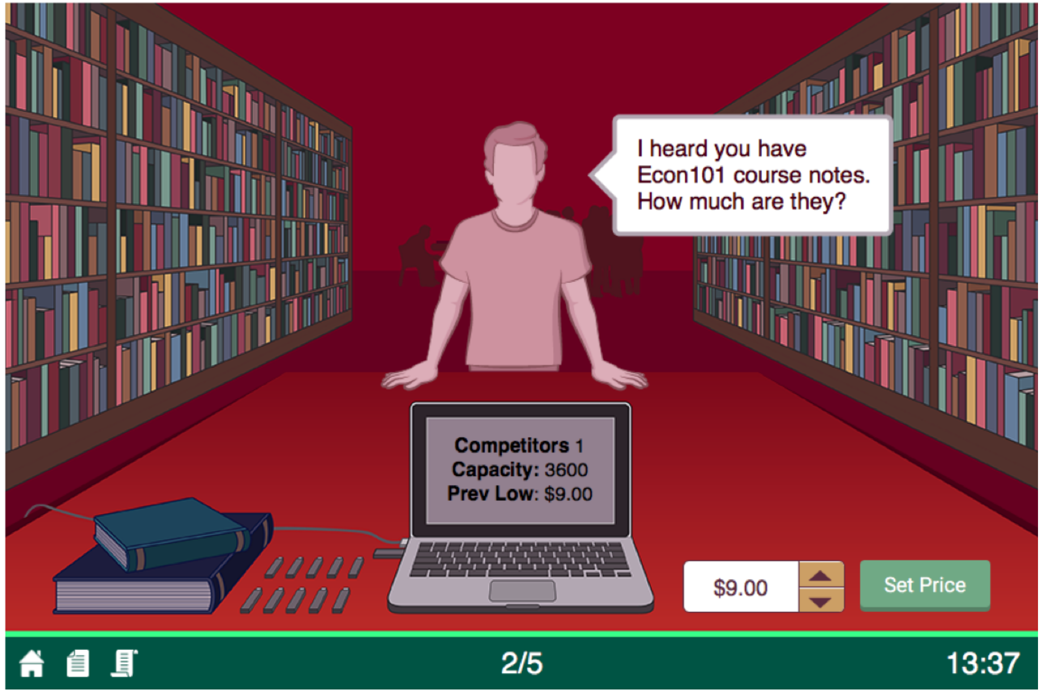

Example:

- Suppose Firm 1 sets $p = 9$ and Firm 2 sets $p = 10$
- Firm 2 sells 0, makes $0 profit
- Firm 1 sells $q = 3,600 - 200(9) = 1,800$ and earns $1,800(9 - 2) = 12,600$ profit

Models of Oligopoly

Three canonical models of Oligopoly

1. Bertrand competition
   - Firms **simultaneously** compete on **price**
2. Cournot competition
   - Firms **simultaneously** compete on **quantity**
3. Stackelberg competition
   - Firms **sequentially** compete on **quantity**

Bertrand Competition

Joseph Bertrand

1822-1890

- "**Bertrand competition**": two (or more) firms compete on **price** to sell the **same good**
- Firms set their prices **simultaneously**
- Consumers are indifferent between the brands and **always buy from the seller with the lowest price**

Bertrand Competition: Example

- Suppose two firms, **Walmart** and **Target** stock and sell identical HDTVs
- Costs each firm $200 to stock an HDTV
- Let Q be the *total* quantity purchased by consumers from the entire market (i.e. both firms)
  - $Q = q_w + q_t$
- Denote **Walmart**'s price as p_w and **Target**'s price as p_t

Bertrand Competition: Example

- Demand for HDTV's at **Walmart**:

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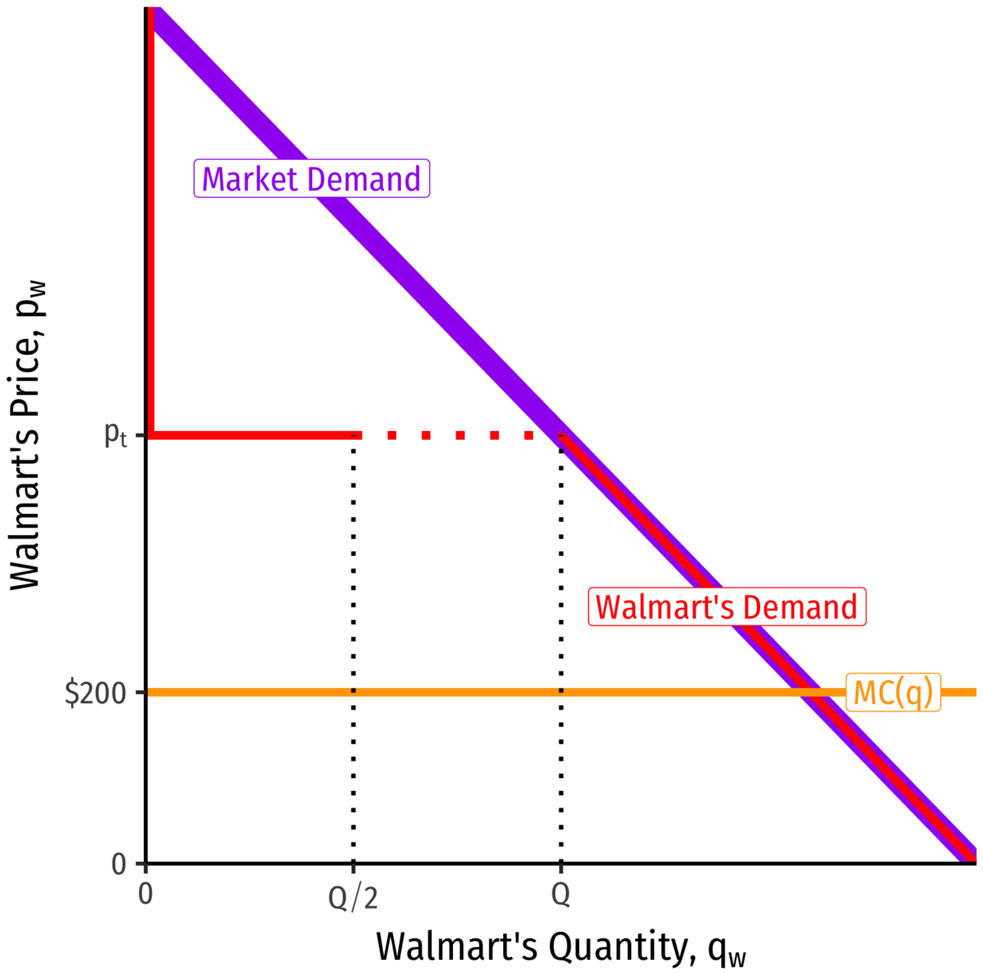

Bertrand Competition: Example

- Demand for HDTV's at **Walmart**:
  - Q if $p_w < p_t$
  - $\frac{Q}{2}$ if $p_w = p_t$
  - 0 if $p_w > p_t$

- Demand for HDTV's at **Target**:
  - 0 if $p_w < p_t$
  - $\frac{Q}{2}$ if $p_w = p_t$
  - Q if $p_w > p_t$

Bertrand Competition: Example

- The only way to sell TVs is to match or beat your competitor's price

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- Suppose you are **Walmart**

For a known p_t, setting your price

$$p_w = p_t - \epsilon$$

for any arbitrary $\epsilon > 0$ captures you the entire market Q

- Same for **Target** for p_w

Bertrand Competition: Example

- Won't charge $p < MC$, earn losses
- Firms continue undercutting one another until $p_w = p_t = MC$
- **Nash Equilibrium**:

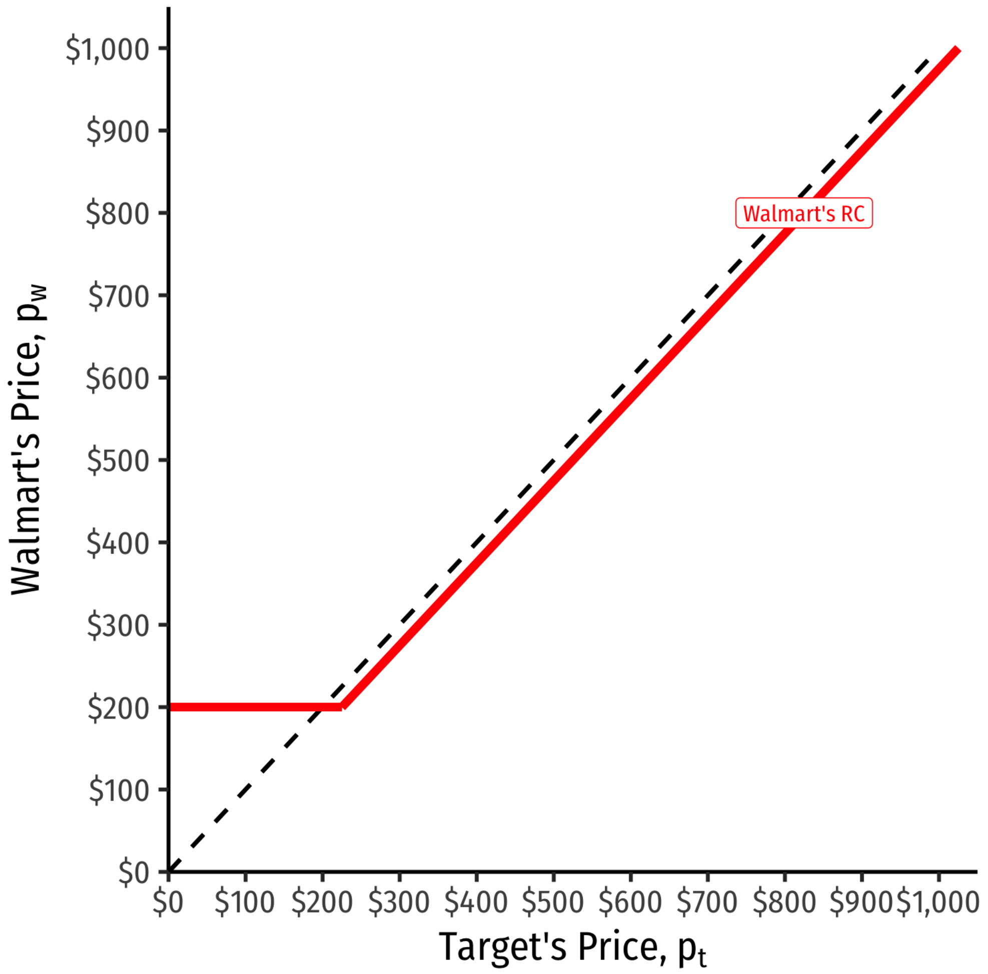
$$\left(p_w = MC, p_t = MC\right)$$

  - Firms earn no profits!

Bertrand Paradox

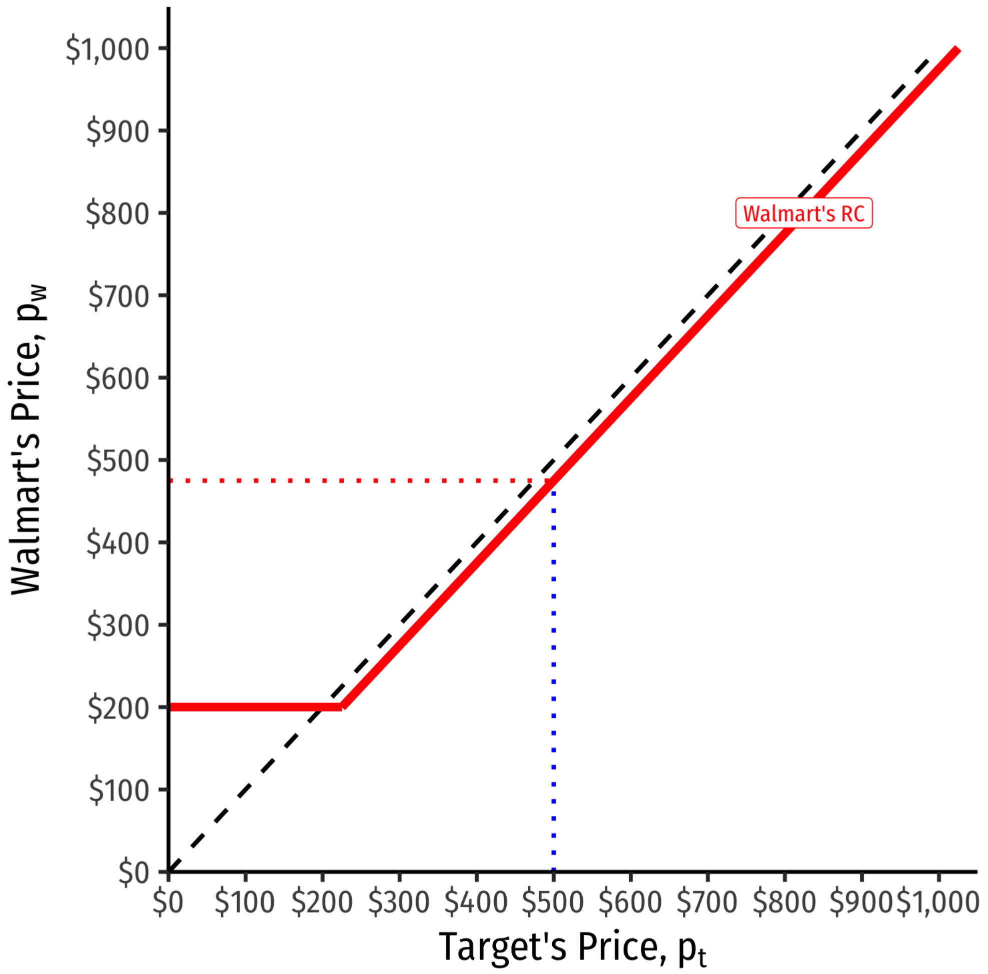
- **Bertrand Paradox**: competitive outcome can be achieved with just 2 firms!
  - $p = MC, \pi = 0$

Walmart's Reaction Curve



We can graph **Walmart**'s **reaction curve** to **Target**'s price

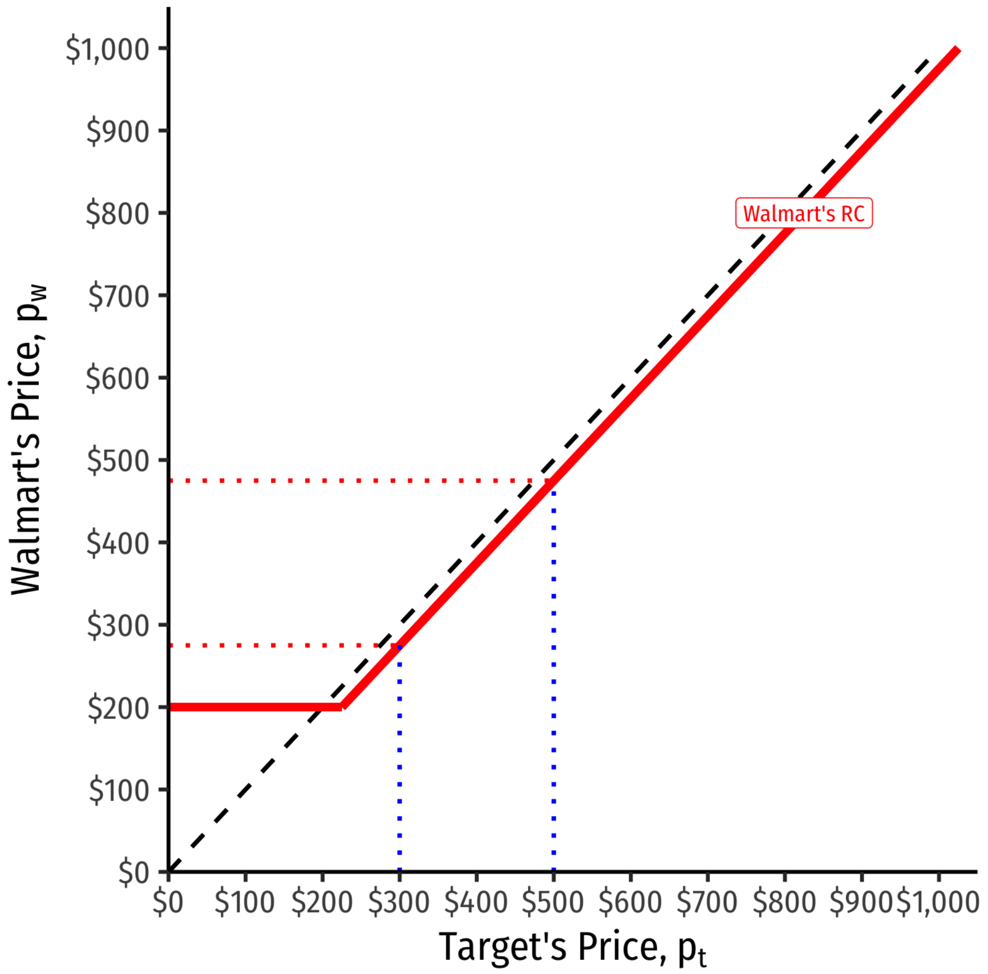
Walmart's Reaction Curve



We can graph **Walmart**'s **reaction curve** to **Target**'s price

- e.g. if **Target** sets a price of **$500**, **Walmart**'s best response is $\$500 - \epsilon$

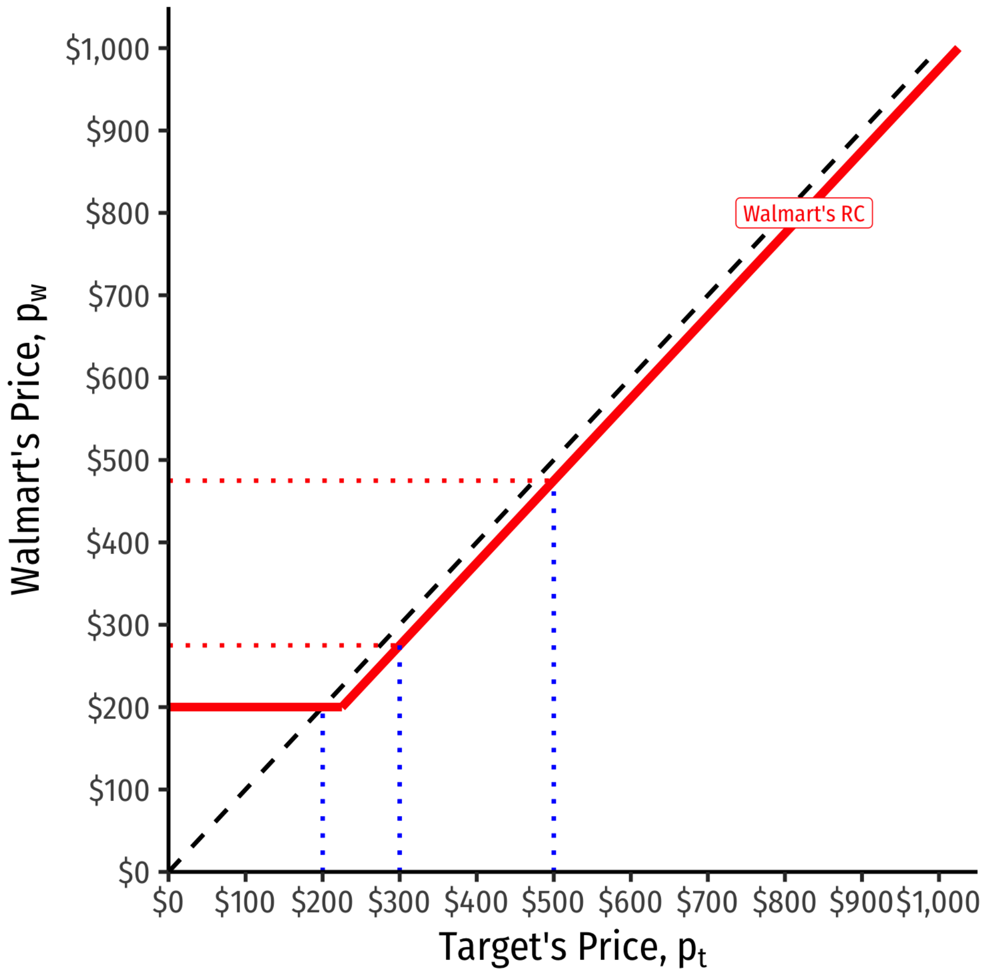
Walmart's Reaction Curve



We can graph **Walmart**'s **reaction curve** to **Target**'s price

- e.g. if **Target** sets a price of **$500**, **Walmart**'s best response is $\$500 - \epsilon$
- e.g. if **Target** sets a price of **$300**, **Walmart**'s best response is $\$300 - \epsilon$

Walmart's Reaction Curve



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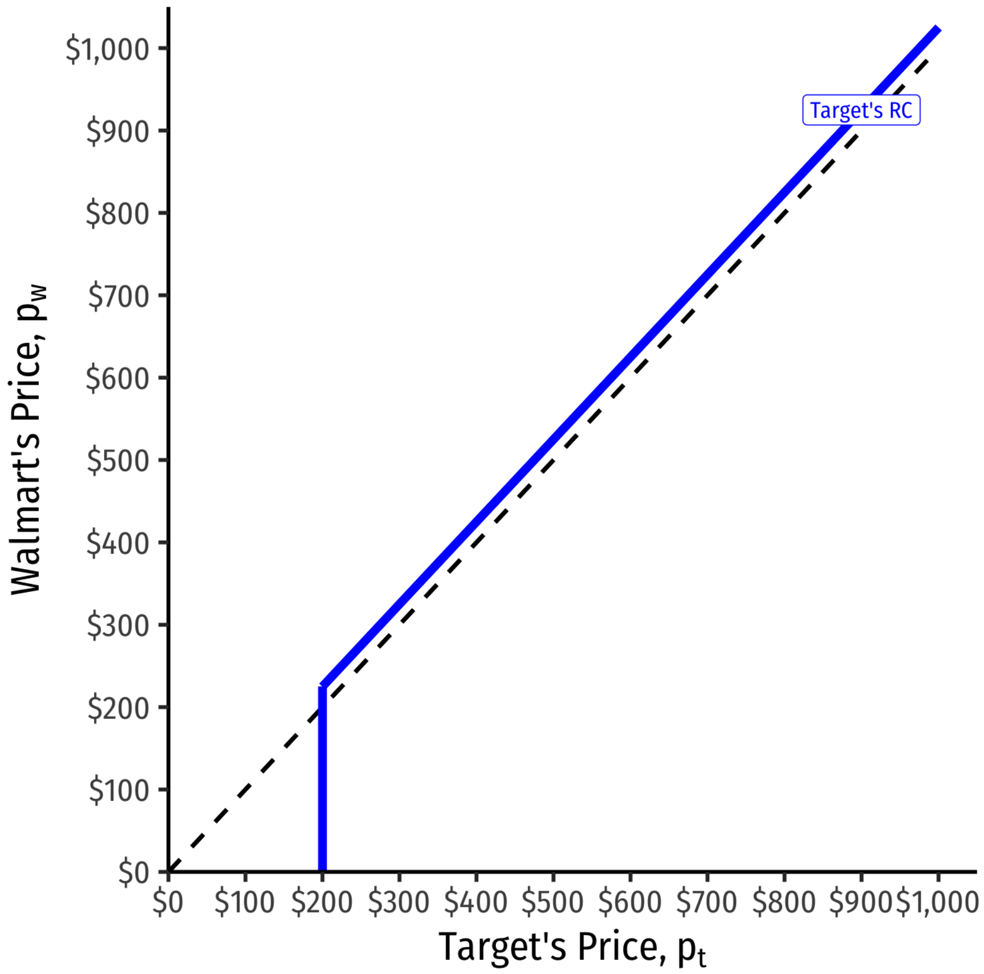
- e.g. if **Target** sets a price of **$300**, **Walmart**'s best response is $\$300 - \epsilon$
- e.g. if **Target** sets a price of **$200**, (MC) **Walmart**'s best response is $\$200$ (MC)

Target's Reaction Curve



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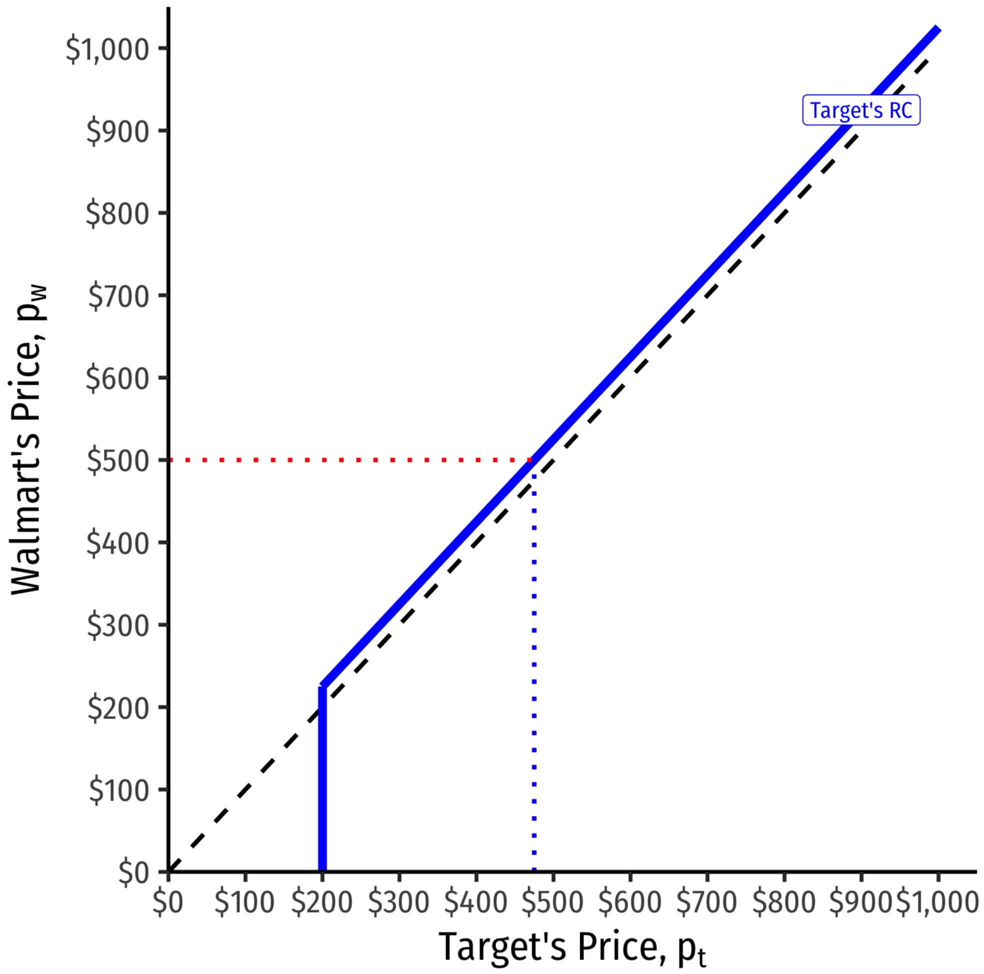
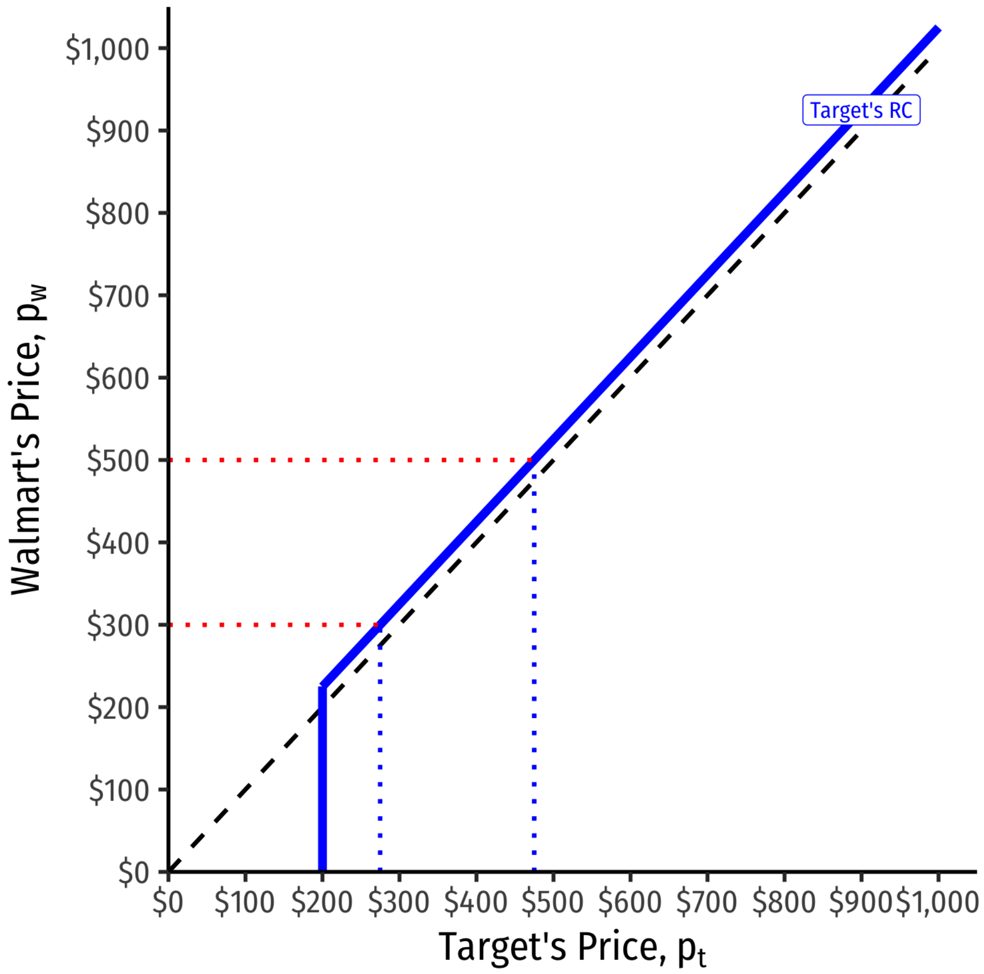
Target's Reaction Curve



We can graph **Target**'s **reaction curve** to **Walmart**'s price

- e.g. if **Walmart** sets a price of **$500**, **Target**'s best response is $\$500-\epsilon$

Target's Reaction Curve



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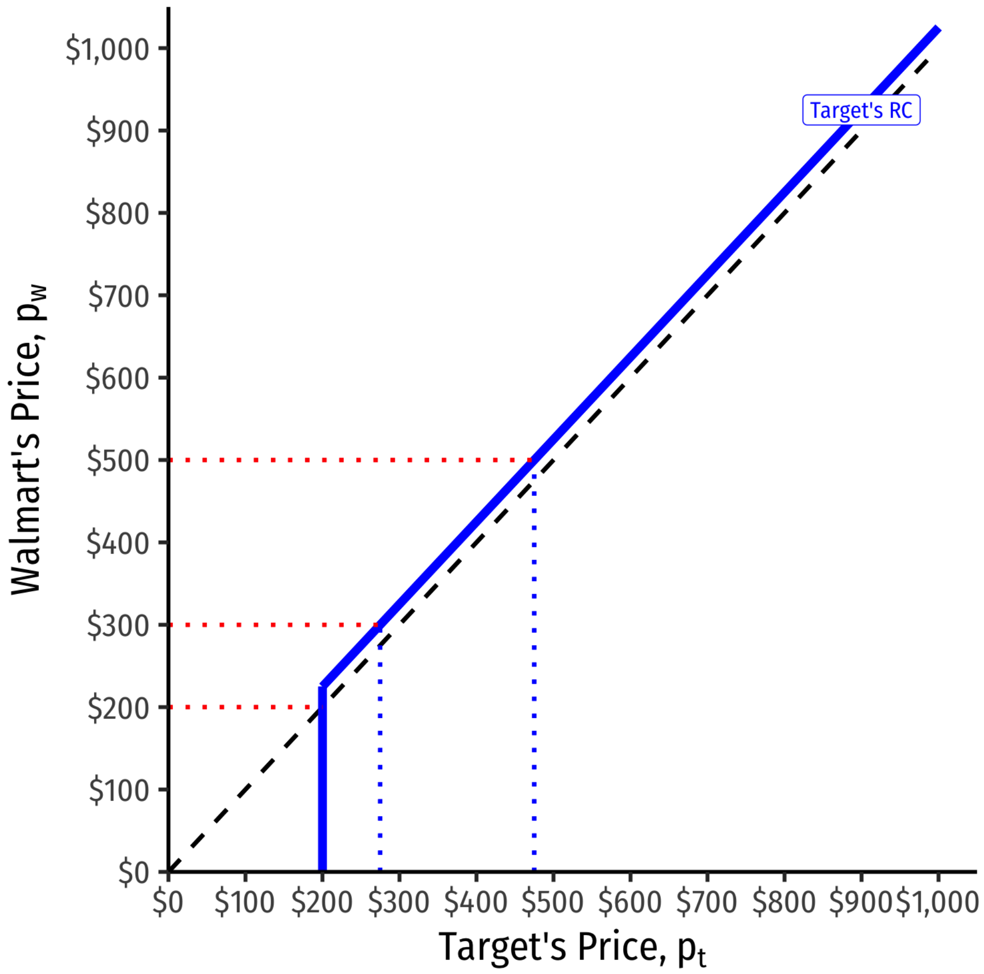
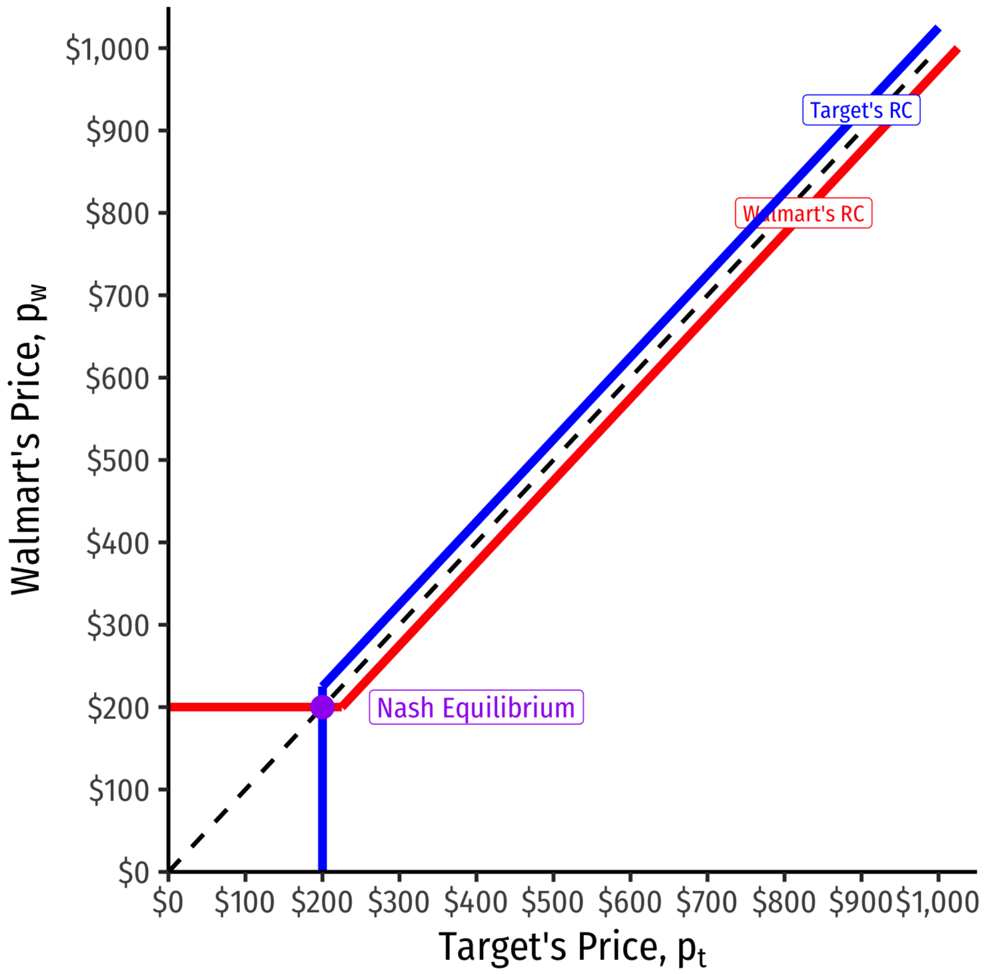
Target's Reaction Curve



We can graph **Target**'s **reaction curve** to **Walmart**'s price

- e.g. if **Walmart** sets a price of **$500**, **Target**'s best response is $\$500-\epsilon$
- e.g. if **Walmart** sets a price of **$300**, **Target**'s best response is $\$300-\epsilon$
- e.g. if **Walmart** sets a price of **$200** (MC), **Target**'s best response is $\$200$ (MC)

Nash Equilibrium with Reaction Curves



Combine both curves on the same graph

- **Nash Equilibrium**:

$$\left(p_w = MC, p_t = MC\right)$$

  - Where both reaction curves intersect

- No longer an incentive to undercut or change price