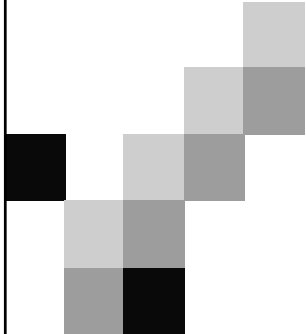




University of Nevada, Reno
Statewide • Worldwide



THE ECONOMIC THEORY OF PRICING: A Presentation for Rust Bullet

Elliott Parker, Ph.D.
Professor of Economics
University of Nevada, Reno
<http://www.coba.unr.edu/faculty/parker>

October 14, 2008

1

Objectives of the Lecture

Part I: The Economic Theory of Pricing

- Overview of the Firm and its Costs
- How to Maximize Profits
- Types of Markets
- Pricing
- Supply and Demand



2

Firm Structure

Most production in the U.S. is from privately-owned firms, and there are three basic types:

- Sole proprietorships
 - ~ around 80% of firms, 10% of sales.
- Partnerships
 - ~ around 10% of firms, 10% of sales.
- Corporations
 - ~ around 10% of firms, 80% of sales.

3

Corporations

- Larger firms usually require funds from multiple owners. Pooling funds from multiple owners requires some protection.
 - Limited liability – owners can't lose more than financial investment in firm.
 - Legal personhood – firm can survive owners, appoint officers, sign contracts, pay taxes, be sued, et cetera.
- Ownership divided into shares of stocks:
 - Owners receive dividends: net profits minus taxes minus corporate savings, divided by the number of shares.
 - Firm may be privately held or publicly traded.
- Leveraging – owners may rely in part on debt instead of equity, which increases risk and return for owners.

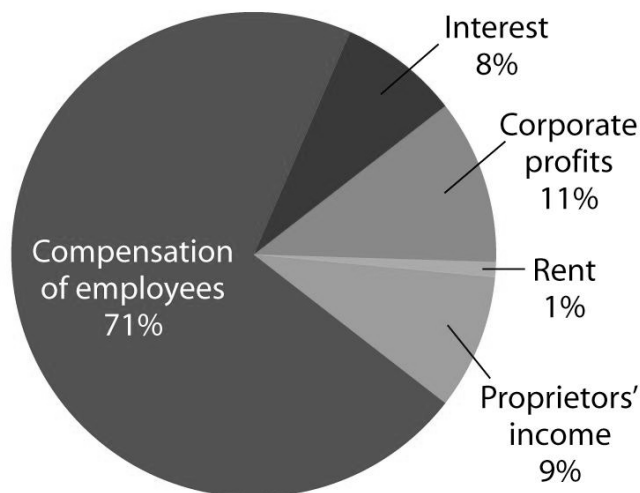
4

What are Production Resources?

- Labor
 - includes time, effort, and skills
 - Skills and ability can be called "Human Capital"
- Capital
 - Produced, productive assets.
- Natural resources
 - Land, mineral rights, et cetera.
- Entrepreneurship and management
 - Risk-taking usually connected to capital investment.
 - In corporations, management and ownership are usually separated.

5

Distribution of Resource Income in the United States, 2003



6

Capital – produced, productive assets

- Capital includes factories, machinery, housing, etc.
- Financial capital (paper wealth) includes rights to income produced by real capital.
- Capital is very specific to firm, and usually the residual claimant (profits).
- When capital is purchased, this is investment.
- When capital is consumed through use, time or obsolescence, this is depreciation.

7

The Firm's Costs

- An **explicit cost** is a cost that involves actually laying out money. This includes wages for labor, cost of benefits, taxes, rents, cost of materials, advertising, franchise fees, taxes, interest on loans, et cetera.
- An **implicit cost** does not require an outlay of money; it is measured by the value, in dollar terms, of the benefits that are forgone.
- Costs can be monetary (pecuniary) or not. Nonpecuniary costs are still real, but harder to measure.
- Even free goods may have opportunity costs. Water in a river has multiple, competing uses.

8

Opportunity Cost

- An opportunity cost is what you give up to do something, relative to the next best alternative. It may be explicit or implicit.
- If you quit a former job in order to become a Rust Bullet distributor, the income you gave up is part of your opportunity cost.
- If you were unemployed, then you would use the income you might have earned, or the value of your free time, instead.
- If you are using your own savings to invest in your firm, then the interest you could have earned with it is still part of your opportunity cost.

9

Fixed and Variable Costs

- A fixed cost does not change in the short run, and does not affect pricing and production decisions in the short-run.
 - Sunk costs are nonrecoverable, even if you shut down production.
 - Some fixed costs are recoverable: utility bills, salvage value of equipment, et cetera.
- A variable cost rises with increased production, and are crucial to know if you want to maximize profits. Shutting down operations will reduce variable costs to zero.
- All costs are variable in the long run.
- Decision-makers often find it easier to consider average costs, not just total costs.

10

Economies and Diseconomies of Scale

- There are **economies of scale** when long-run average total cost declines as output increases. This is likely when fixed costs are large.
- There are **diseconomies of scale** when long-run average total cost increases as output increases. This is likely when larger firms are harder to manage.
- There are **constant returns to scale** when long-run average total cost is constant as output increases. This is likely when firms have an optimal unit size, and can set up multiple units.

11

Profit and Cost

- Firms must also take into consideration all costs when they determine their profit.
- **Profit** is defined as what is left over after all costs have been subtracted from the total revenue.
- Net profits subtract both fixed and variable costs.
- Gross profits subtract only variable costs.
- Accounting profit subtracts explicit costs and implied depreciation on capital.
- Economic profit subtracts all explicit and implicit costs.

12

An Example

- Suppose you distribute a product that sells for \$140 per gallon, and the factory price is \$100. You have \$5000 per week in explicit fixed costs, like rent, utilities, and franchise fees, and your only explicit variable cost is labor, which costs you \$600 per worker per week, including benefits and payroll taxes.
- Suppose you sell 500 gallons per week on average, and this takes 12 workers to get it done.
- Your gross accounting profit is $\$70,000 - \$50,000 - \$7,200 = \$12,800$ per week.
- Your net accounting profit is $\$12,800 - \$5000 = \$7800$.
- These numbers are illustrative only, and not to be taken too seriously.

13

What about your implicit costs?

- Suppose that you could be earning \$1500 per week working for somebody else.
- Suppose that you must permanently carry two week's inventory, and you also need \$40,000 worth of equipment. So you use \$140,000 of your own savings, and you could have earned 6% per year, or about \$160 per week.
- You have implicit fixed costs of \$1,660, so your net economic profit is \$6,140.
- If you have to borrow this money, the interest becomes explicit.
- Another implicit cost might be a fair reward for the additional risk you are taking – the risk premium.

14

Profit Maximization

- In a privately-owned, capitalist economy, the ultimate objective of the firm is to maximize profit over the long-run.
- Profit-maximization may be intentional or unintentional. Owners often lack enough information to do it on purpose, but they try different things and imitate other firms, and keep doing what works.
- Firms that do not maximize profits over the long-run tend to go out of business. This includes firms that maximize profits in the short-run at the expense of the long-run.

15

How do we maximize? Marginal Analysis

- Marginal analysis requires us to compare the benefit of doing a little bit more of an activity with the cost of doing that little bit more.
- Marginal analysis is called that because we always make decisions at the margin. Relative to what we are doing at any moment, we push the edge farther out and see if it is a good move.
- The **maximization principle** of marginal analysis says that the optimal quantity of an activity is the quantity at which the Marginal Value is equal to the Marginal Cost.

16

Marginal Analysis

- $MV = \Delta V / \Delta X$

- $MC = \Delta C / \Delta X$

Where X = any choice variable, holding everything else constant.

- If $MV > MC$, we do more.
- If $MV < MC$, we do less.
- We stop doing more when $MV = MC$.

17

Back to our Example:

<u>Output</u>	<u>Revenue</u>	<u>Workers</u>	<u>Labor Costs</u>	<u>Factory Cost</u>	<u>Fixed Costs</u>	<u>Total Cost</u>	<u>Net Profit</u>	<u>MR</u>	<u>MC</u>
0	0	0	0	0	\$6,660	\$6,660	-\$6,660		
100	\$14,000	2	\$1,200	\$10,000	6,660	17,860	-3,860	\$140	\$112
200	28,000	3	1,800	20,000	6,660	28,460	-460	140	106
300	42,000	5	3,000	30,000	6,660	39,660	2,340	140	112
400	56,000	8	4,800	40,000	6,660	51,460	4,540	140	118
500	70,000	12	7,200	50,000	6,660	63,860	6,140	140	124
600	84,000	17	10,200	60,000	6,660	76,860	7,140	140	130
700	98,000	23	13,800	70,000	6,660	90,460	7,540	140	136
800	112,000	30	18,000	80,000	6,660	104,660	7,340	140	142
900	126,000	38	22,800	90,000	6,660	119,460	6,540	140	148
1000	140,000	47	28,200	100,000	6,660	134,860	5,140	140	154

Profit is maximized at the point where $MR = MC$.

18

What if the outcome is uncertain?

- Suppose there is a 40% chance you will sell 500 gallons, but a 60% chance you may sell more or less?
- Let us estimate there is a 10% chance each that you will sell 100, 200, 300, 400, 600, or 700 gallons.
- The “expected value” of sales will equal only 430 gallons.
- In general, **Expected Value** = sum of all probabilities times value of all outcomes, or:
$$EV = p_1 \times O_1 + p_2 \times O_2 + p_3 \times O_3 + \dots + p_n \times O_n$$
where $p_1 + p_2 + p_3 + \dots + p_n = 1$

19

What if the outcome takes time?

- If you put \$140,000 in an equally risky asset that earned 6% annually, you could have earned \$8,400 in a year, in addition to getting the principal back.
- This is called the **future value** (FV) formula:
$$FV = \text{Present Amount of Principal} \times (1+r)$$
where r is the interest rate per period (year).
- In two years you would have earned \$17,304, in three years \$26,742, et cetera.
- This is called compounding:
$$FV = \text{Present Amount of Principal} \times (1+r)^n$$
where n is the number of periods.

20

Working backwards

- Suppose the market is doing badly now, and we are only selling 100 gallons per week. In two years, we expect sales to rise to 500. After five years, we want to retire.
- Assuming we work 50 weeks a year, we would lose \$193,000 this year and next, and make \$307,000 for the three years after.
- What is the value of \$307,000 in five years?
- This result is called the **present value** (PV) of future income.

$$PV = \frac{FV}{(1+r)^t} = FV \cdot (1+r)^{-t}$$

21

So is it worth it?

- Assuming you are right, and that your costs and prices don't change over the five years, then at a 6% opportunity cost of time:
 - \$307,000 in 5 years is worth \$229,408 now.
 - \$307,000 in 4 years is worth \$243,173 now.
 - \$307,000 in 3 years is worth \$257,763 now.
 - -\$193,000 in 2 years is worth -\$171,769 now.
 - -\$193,000 in 1 years is worth -\$182,074 now.
- The net present value is thus \$377,500.
- Doing this by week instead of year would get a result of \$387,460. Close enough.

22

Leveraging and the Risk-Return Tradeoff

- Leveraging is the use of debt to raise the return on your capital. It also raises the risk.
- For example, suppose that you make a \$200K investment that has a 50% chance of being worth \$400K in a year, and a 50% chance of being worth only \$100K. The expected value is \$250K, and the expected return is 25%. You may double your investment, or halve it.
- Suppose instead that you borrow \$100K to make the investment, and match it with your own funds. Assuming you could borrow at 6%, you would have an expected return of 44%. You might turn \$100K into \$294K, but you might lose it all and still owe the bank \$6K in interest.
- A 25% leverage ratio → less risk, expected return of 31%.
- A 75% leverage ratio → more risk, expected return of 82%.
- These numbers are only illustrative, but the principle is real.

23

Can we control the price too?

- It depends on the type of market, the characteristics of the product, the number of close competitors, and the consumer's information.
- In our example, we assumed the firm was a price taker at \$140 per gallon, but we also assumed that the firm could only sell 500 gallons per week (or an expected 430 gallons) when the optimal amount was 700.
- What if you could sell 500 gallons at \$140, but for every \$5 you cut (raised) the price, you would sell 100 gallons more (less)?

24

What are the marginal conditions?

- Set $MV = MC$ as a function of P
- $MVP = \Delta R / \Delta P = (\Delta R / \Delta Q) \times (\Delta Q / \Delta P)$
- $MCP = \Delta C / \Delta P = (\Delta C / \Delta Q) \times (\Delta Q / \Delta P)$
- So this is the same as $MR=MC$

Marginal Revenue depends on the elasticity of demand:

- $MR = P \times (1 - 1/ED)$
- $ED = (\Delta Q / Q) / (\Delta P / P)$

25

Let's Adjust our Example:

<u>Price</u>	<u>Output</u>	<u>Revenue</u>	<u>Total Cost</u>	<u>Net Profit</u>	<u>ED</u>	<u>MR</u>	<u>MC</u>
\$165	0	0	\$6,660	-\$6,660			
160	100	\$16,000	17,860	-1,860	32.0	\$160	\$112
155	200	31,000	28,460	2,540	15.5	150	106
150	300	45,000	39,660	5,340	10.0	140	112
145	400	58,000	51,460	6,540	7.3	130	118
140	500	70,000	63,860	6,140	5.6	120	124
135	600	81,000	76,860	4,140	4.5	110	130
130	700	91,000	90,460	540	3.7	100	136
125	800	100,000	104,660	-4,660	3.1	90	142
120	900	108,000	119,460	-11,460	2.7	80	148
115	1000	115,000	134,860	-19,860	2.3	20	154

Profit is still maximized at the point where $MR = MC$, but now MR falls fast. Before, we assumed it was \$140.

26

Mark-Up Pricing

- Decision-makers don't often have the information necessary to calculate marginal revenue and marginal cost.
- Instead, decision-makers often use rules of thumb to try to find the right choice. If they are lucky, these rules of thumb approximate the right answer.
- To use a mark-up, one must first estimate the average fixed cost, including explicit and implicit costs.

27

What is the appropriate Mark-up?

- $AFC = FC/Q$.
- In our example, explicit fixed cost per week is \$5000, and implicit fixed cost is \$1660. If we expect to sell 500 gallons, this is \$13.30 per gallon.
- Variable costs are \$100 per gallon for factory costs, and \$7200 in labor costs. At 500 gallons, this is \$114.40 per gallon.
- Our break-even price is therefore \$127.70.
- As a share of the factory cost, our markup is 28% (or more).
- If we sell either 400 or 600 gallons, however, we lose money.

28

Markups in the real world

- Markups are often based on past experience, which can be good or bad.
- Markups remind us that our company's long-run survival depends on our covering both our fixed and variable costs, both implicit and explicit, but optimal markups are dependent on the quantity we can sell.
- Implicit costs of capital include the rate of depreciation, and the risk-adjusted interest rate (together, these are the internal rate of return).
- If you are able to calculate marginal revenue and marginal cost, however, this should perform better.

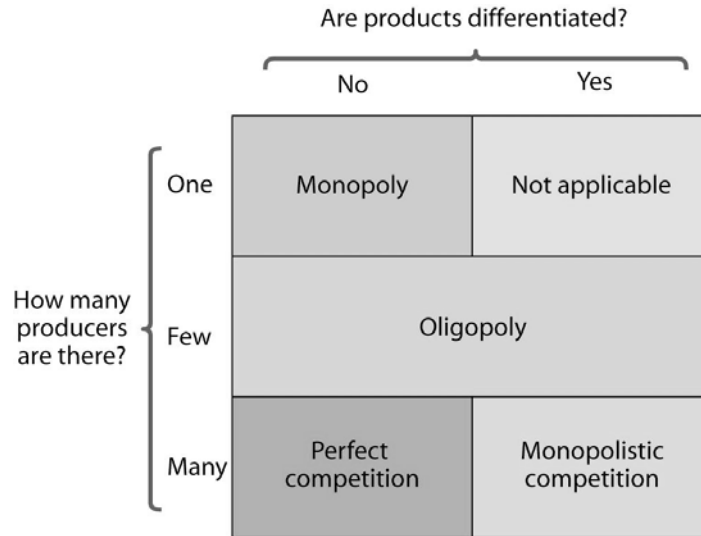
29

How to use a markup?

- It depends on whether it is given as a share of price, a share of the material cost, a share of variable cost, or a share of explicit cost.
- For example, mark-ups are often given as a rate of return on sales. In that case:
 - $P = C / (1 - MU)$
- If the mark-up is given as a share of factory cost, then that would be:
 - $P = C \times (1 + MU)$
- It helps, however, to know your market...

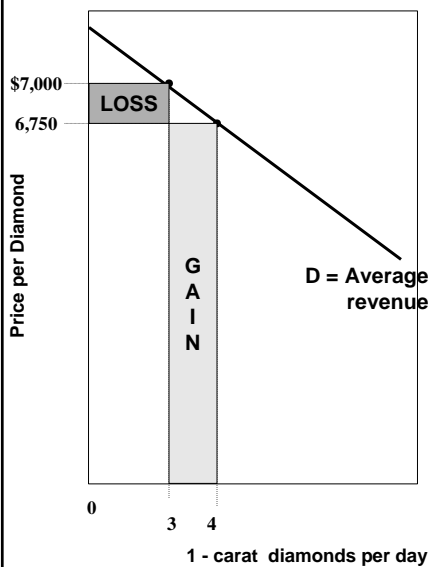
30

Types of Market Structure



31

Loss or Gain from Selling One More Unit: DeBeers as a monopolist in the Diamond Market



■ By selling another diamond, De Beers gains the revenue from the sale of the 4th diamond

■ To sell the 4th unit, De Beers must sell all four diamonds for \$6,750 each, sacrificing \$250 on each of the first three diamonds that could have been sold for \$7,000 each

■ The loss in revenue from the first three units is \$750

■ The net change in total revenue from selling the 4th diamond is $\$6,750 - \$750 = \$6,000$

32

The slope of the MR Curve

- If demand is linear, then the MR curve is twice as steep.
If demand is $P=100 - 5 \times Q$, then $MR = 100 - 10 \times Q$.
- In general, $MR/P = 1 - 1/|E_D|$, where $|E_D|$ is the absolute value of elasticity demand.
 - If $E_D = -5$ (very elastic), MR is 80% of P.
 - If $E_D = -2$ (elastic), MR is half of P.
 - If $E_D = -1$ (unit elastic), $MR = 0$.
 - If $E_D = -0.5$ (inelastic), $MR < 0$.
- Therefore, since $MC > 0$, the firm always choose to sell where its own demand is elastic, though overall market demand may be inelastic.

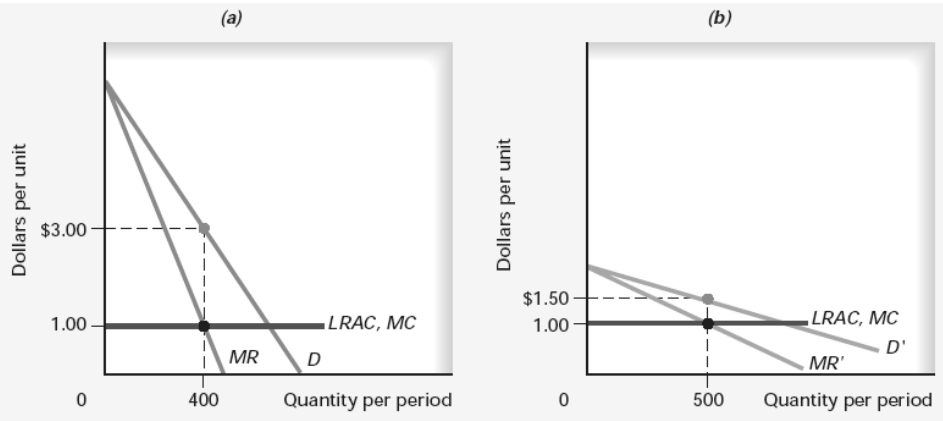
33

Price Discrimination

- If firms can identify different groups of customers with different demand elasticities, and prevent one group from reselling to others, then the firm can price discriminate.
- Cost-based price differences (e.g., quantity discounts, peak-load pricing) is not price discrimination.
- Examples of price discrimination:
 - Airlines have different prices for tourists and business travelers, and different prices depending on when you buy and when you travel.
 - Movie theaters have children, adult, and senior prices.
 - Casinos often discriminate between tourists and locals.
 - Supermarkets offer lower prices to coupon-clippers.
- If a firm with market power could charge a different price for *each* unit sold, the firm's marginal revenue curve from selling one more unit would equal the price of that unit. This is *perfect price discrimination*.

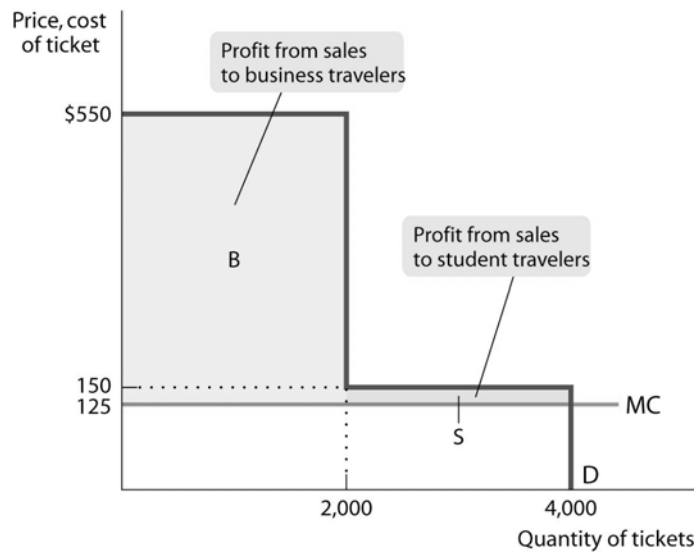
34

Price Discrimination

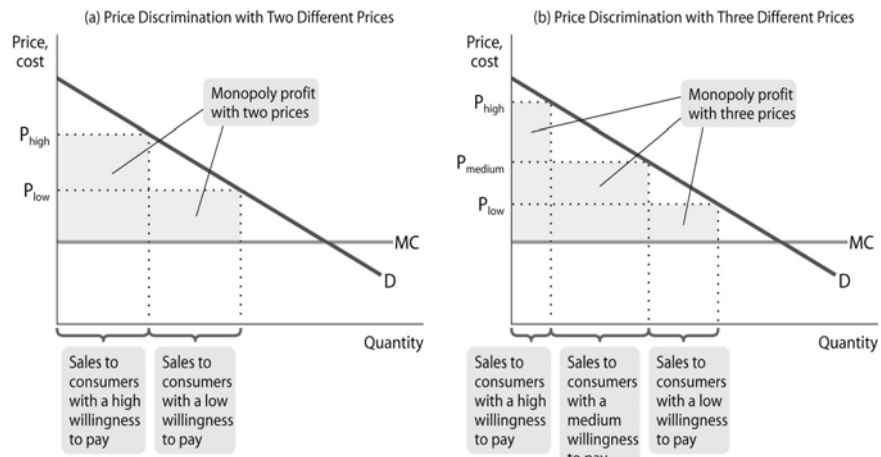


•At a given price, price elasticity of demand (panel b, elastic) is greater than in panel a (inelastic).

Price Discrimination: Airline Customers



Price Discrimination: Two versus Three



By increasing the number of different prices charged, the firm can make a larger profit, and has incentive to produce more, as long as $P > MC$.

37

Type of Products

- Homogeneous products: each firm sells similar commodities.
 - Examples include petroleum products, coal, steel, aluminum.
 - Firm's demand elasticity is high if price differs from others.
- Differentiated products: each firm is able to distinguish the products it sells from the products of other firms in the market, but there are still barriers to entry and few producers.
 - Examples include automobiles, airlines, airplane manufacturers, breakfast cereals, and personal care products (e.g., deodorants, soaps).

38

Oligopoly

- A market structure characterized by several large firms is called an **oligopoly**. The term comes from the Greek meaning “few sellers.”
- Oligopolies arise from the same forces that lead to monopoly, except in weaker form. Often, new firms are prevented from entering the market by high fixed costs.
- When there are few firms in the market, each firm must consider the effect of its own actions on competitors’ behavior. Firms in an oligopoly are interdependent.
- Firms with very homogeneous products, like coal, will be very sensitive to changes in prices. Small price increases can cause customers to switch to competitors.
- Firms with more differentiated products are less sensitive to changes in competitors prices. Increasing the price on a Ford is not likely to cause buyers immediately to switch to buying Chevrolets.

39

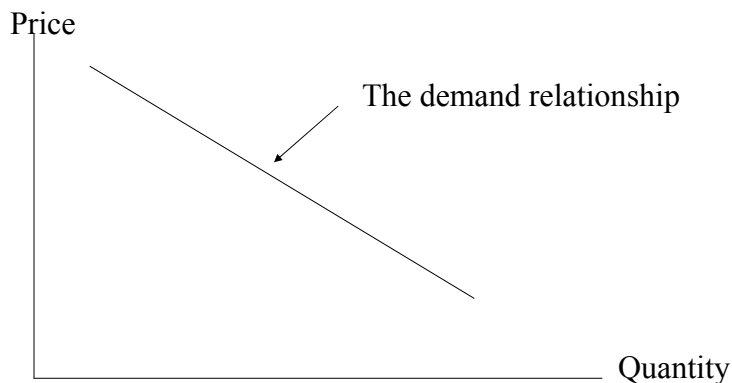
Monopolistic Competition

- Rust Bullet is a monopolistically competitive firm. It has some control over its price, and can raise it without losing all its customers, but it also has competitors producing similar products (e.g., Rustoleum, POR-15).
- Products are not identical, especially in quality. Customers have imperfect information about that quality, and product (and firm) reputation matters.
- Distributors are somewhat more competitive with each other, however, especially since they compete against the company’s own online sales price. To the extent they can’t control their own price, they must concentrate on minimizing average costs to increase profits.

40

The Law of Demand

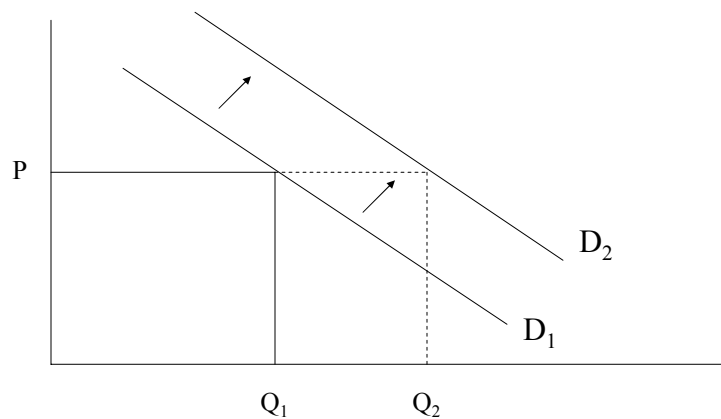
The law of demand is that quantity-demanded has an inverse relationship to price.



The Demand Function

- Demand is not an amount. It is a functional relationship between quantity and price. We can write the demand function as the following:
 - **$q^D = f^D(P; \text{shift variables})$**
- This relationship can change depending on:
 - Preferences or tastes
 - Number of buyers
 - Buyers' Income
 - Prices of related goods (substitutes or complements)
 - Information and expectations

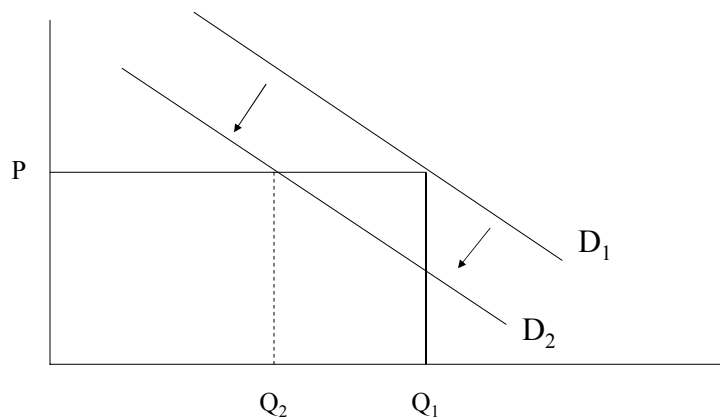
Increase In Demand



What increases Demand?

- An increased preference (e.g., a fad)
- An increase in the number of buyers
- An increase in income (usually)
- An increase in the price of a substitute
- A decrease in the price of a complement
- A change in information or expectations can also increase preferences.
- A decrease in the good's own price does NOT shift demand! Instead, q^D slides along demand.

Decrease In Demand



What decreases Demand?

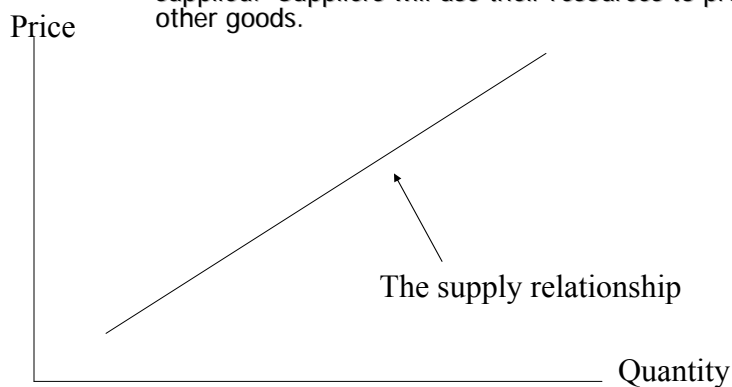
- An decreased preference (e.g., a fad ends)
- A decrease in the number of buyers
- An decrease in income for normal goods, an increase in income for inferior goods.
- A decrease in the price of a substitute, or an increase in the price of a complement.
- A change in information or expectations can also decrease preferences.
- An increase in the good's own price does NOT shift demand!

The Supply Function

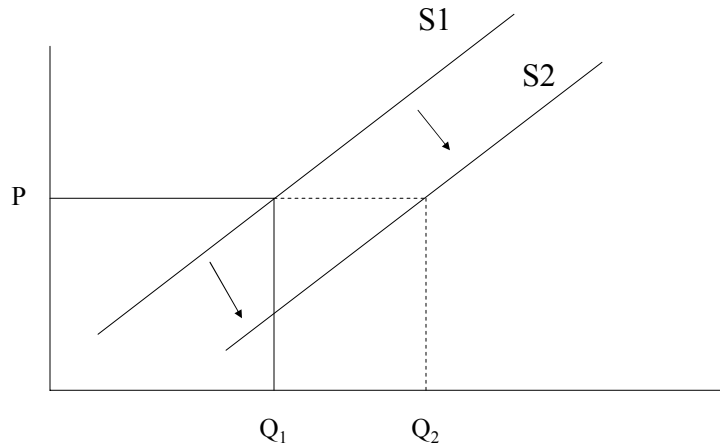
- We can write the supply function as the following:
 - **$q^S = f^S(P; \text{shift variables})$**
- Quantity-supplied is also an endogenous variable.
- Shift variables include:
 - Technology
 - Number of producers
 - Prices of inputs (factors of production)
 - Fixed factors (hard to adjust in the short-run)
 - Prices of related goods (alternative production choices can also be substitutes or complements)
 - Information and expectations

The Law of Supply

The lower the price of a good, the smaller the quantity supplied. Suppliers will use their resources to produce other goods.



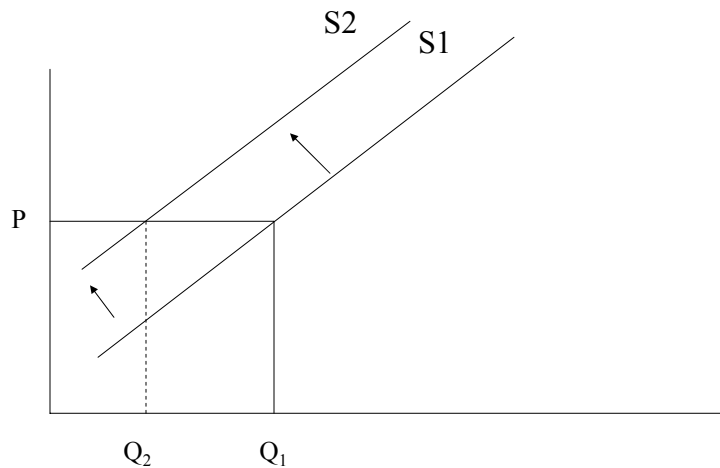
Increase In Supply



What increases Supply?

- A new technology to produce the good using fewer resources.
- An increased number of producers.
- Reduced input prices.
- More available fixed factors.
- Increased prices of byproducts (lumber, plywood), or decreased price for production substitutes (hamburgers vs. hotdogs).
- Information and expectations.
- NOT price.

Decrease In Supply



What decreases Supply?

- Technology does not usually regress, but can be lost.
- An decreased number of producers.
- Increased input prices (cost of production rises).
- Less available fixed factors.
- Decreased prices of byproducts (lumber, plywood), or increased price for production substitutes (hamburgers vs. hotdogs).
- Information and expectations.

Demand and Supply Together

- As price P rises, consumers reduce their quantity-demanded, producers increase their quantity-supplied.
- The price where $q^S = q^D$ is the market-clearing price.
- In a perfectly competitive market, buyers and sellers can choose whether to buy or sell or not at any given price, and how much, but they can't choose the price.
- In a free market, the price is not determined by any central authority, but by the interaction of supply and demand, through "market forces."

Demand and Supply for Pizzas

Suppose that the price for pizzas is initially \$12.

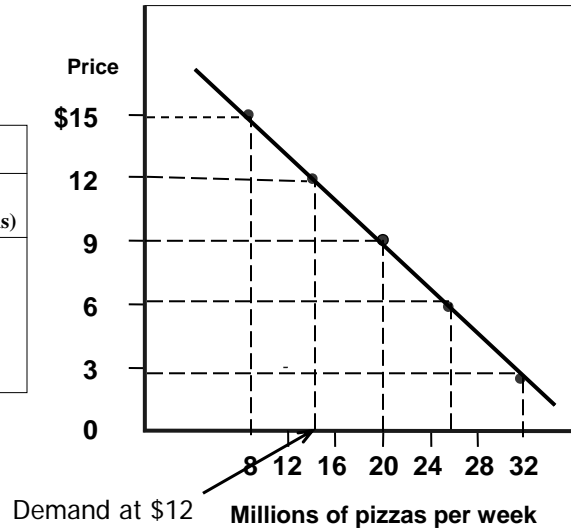
- > From the demand and supply schedules, buyers want 14 million pizzas while suppliers are willing to produce 24 million.
- > This creates a **surplus**.

Demand Schedule	
Price per Pizza	Quantity Supplied per Week (millions)
\$15	8
12	14
9	20
6	26
3	32

Supply Schedule	
Price per Pizza	Quantity Supplied per Week (millions)
\$15	28
12	24
9	20
6	16
3	12

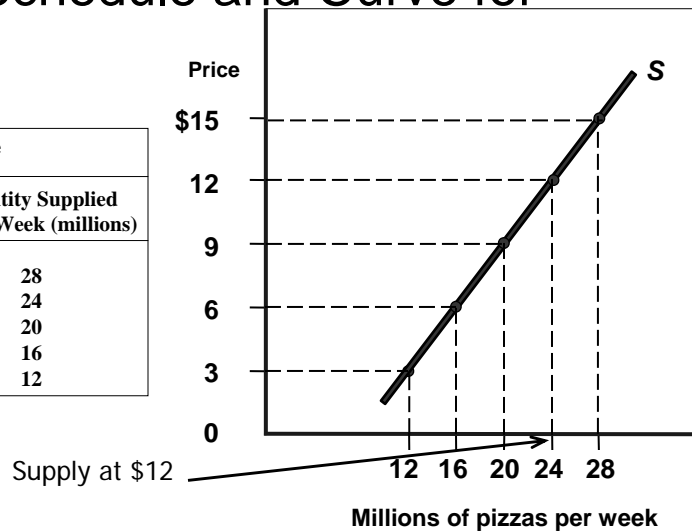
Demand Schedule and Curve for Pizzas

Demand Schedule	
Price per Pizza	Quantity Supplied per Week (millions)
\$15	8
12	14
9	20
6	26
3	32



Supply Schedule and Curve for Pizzas

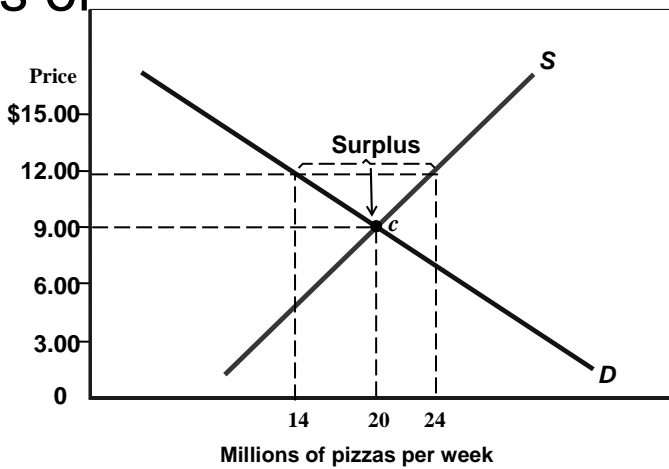
Supply Schedule	
Price per Pizza	Quantity Supplied per Week (millions)
\$15	28
12	24
9	20
6	16
3	12



Surplus

- There is a 10 million pizza surplus: there are more suppliers willing to sell pizza at \$12 than there are buyers who are willing to buy at that price.
- Some of those sellers will begin to lower their price because they have insufficient demand.
- As P falls, more people become willing to purchase pizza.
- As P falls, fewer suppliers are willing to produce pizza.
- Eventually, a price will be reached where all pizzas supplied will be bought at that price.

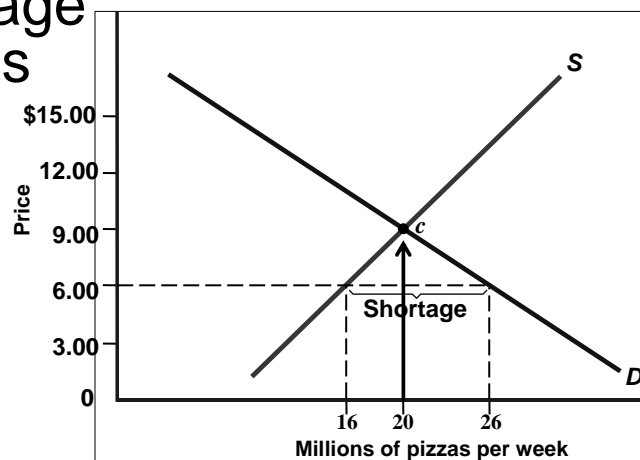
A Surplus of Pizzas



Shortage

- Suppose the price is initially \$6 instead of \$12: now the quantity-demanded for pizzas is 26 million but suppliers are only willing to produce 16 million, so there is a 10 million shortage of pizzas.
- Sellers will begin to raise their price, and some buyers are willing to pay a higher price because they can't find cheaper pizza elsewhere.
- At a higher price, more suppliers are willing to produce pizza, but some buyers are no longer willing to buy it.
- Eventually, there is a price at which everyone willing to buy at that price can get a pizza.

A Shortage of Pizzas

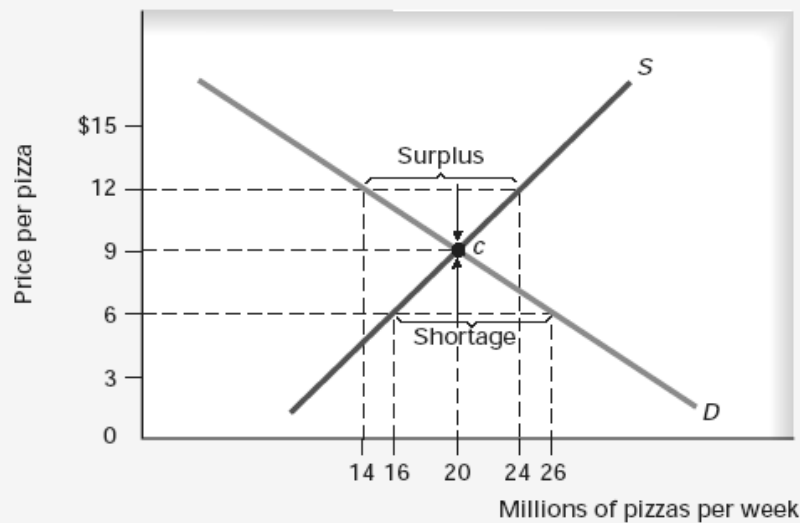


Equilibrium Point

- The market-clearing price is an **equilibrium price**.
- It is “stable” in the sense that any disequilibrium creates market forces that push P towards equilibrium.
- An hypothesis of this model is that any chronic shortage or surplus is caused by some external price control.

The Market for Pizzas

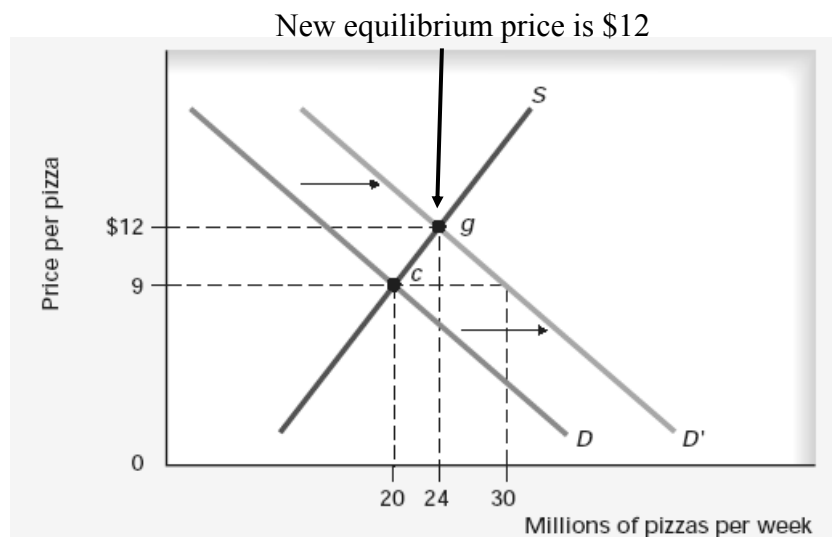
(b) Market curves



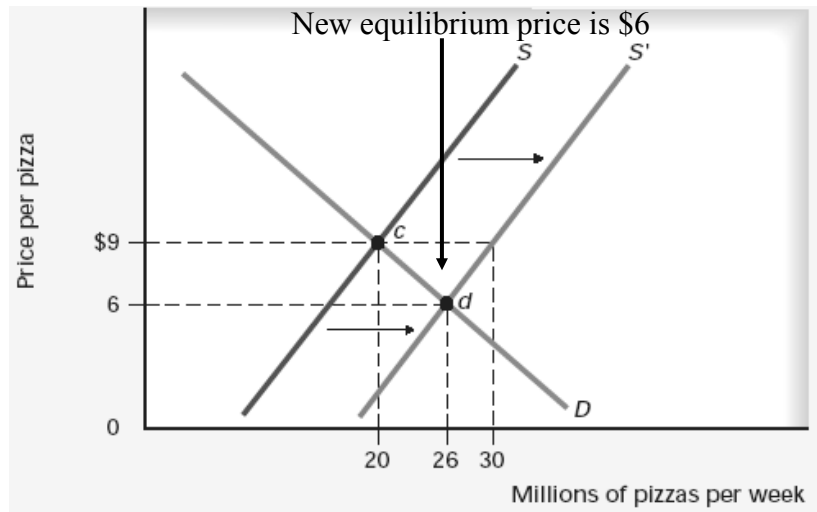
Equilibrium

- Each consumer and each producer makes a personal decision about how much to buy or sell at a given price, but the market requires no conscious coordination among consumers or producers.
- Market forces synchronize the personal and independent decisions of many individual buyers and sellers.
- Once a market reaches equilibrium, that price and quantity will prevail until one of the determinants (shift variables) of demand or supply changes.
- A change in any shift variable will usually change equilibrium price and quantity in a predictable way.

Effects of an Increase in Demand



Effects of an Increase in Supply



In some markets, there may be a bit of a madness to it...



Quality Signaling

- When customers lack information about the product, they look for signals to tell them what the seller thinks of the quality of his or her own product.
- Like good websites, expensive advertising not only attracts attention, it tells the buyer that the seller believes in the product enough to put his money where his mouth is.
- Similarly, the customer notices when the seller makes long-term investments in plant, equipment, a headquarters, a strategy, or a sales staff.
- The price itself also carries a message. Too low of a price may signal poor quality. Too high of a price may signal a short-term commitment to the market.

67

The Famous Four P's

- Product – design, use, mass production, ...
 - Place – physical and virtual location, distribution network.
 - Price – see above. Can be driven by costs, revenues, profits, market share, competition, et cetera.
 - Promotion – making customers aware of it, getting them to try it.
- Other have added: Packaging, People, Process, Physical Evidence, Personalization, Participation, Predictive modeling, and Peer-to-Peer. We could go on, but I'm an economics professor, not a marketing professor.

68