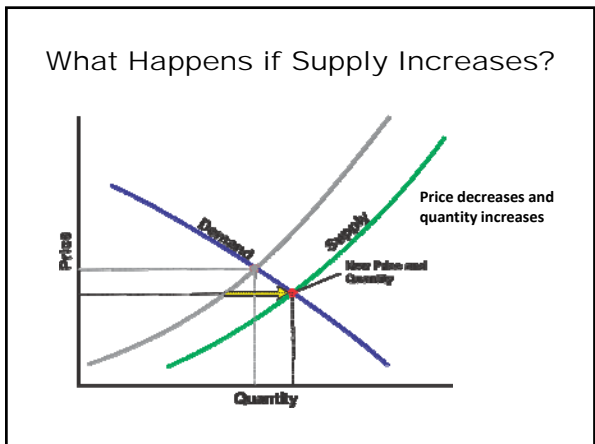
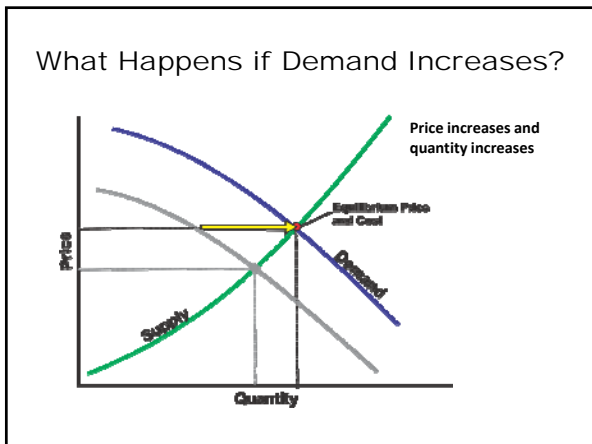
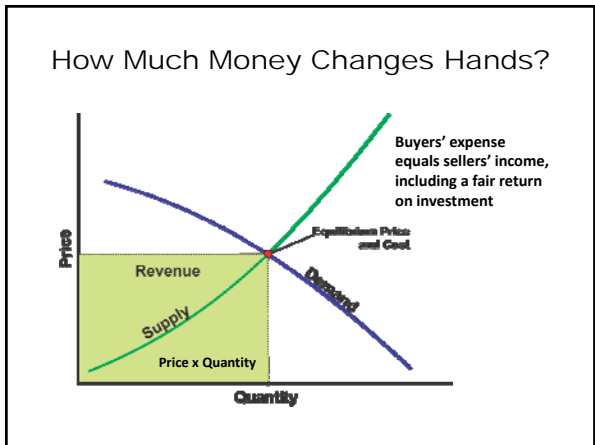
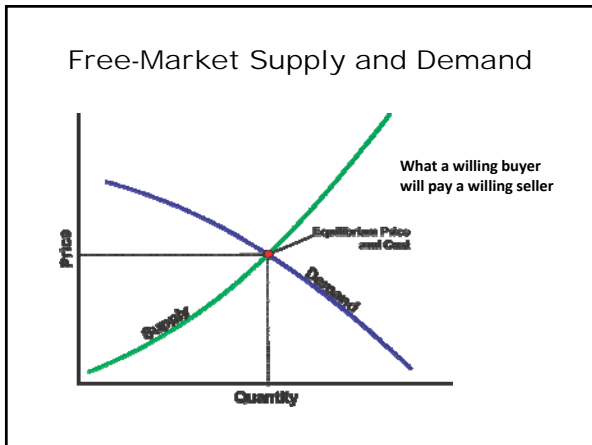


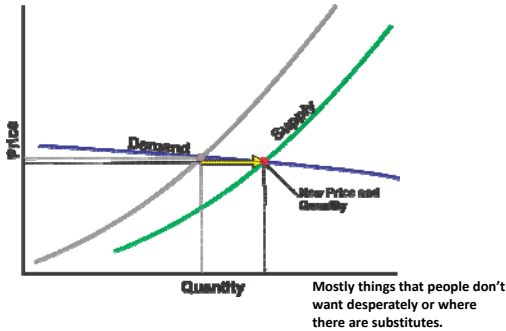


Economics Definitions

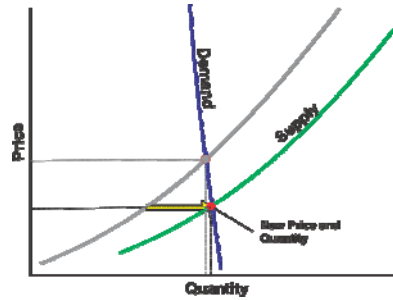
- Adam Smith's (1776) *Wealth of Nations*...
- **Market:** Arena where firms and individuals exchange goods and services (G&S)
- **Supply:** The ability to supply G&S as a function of price
- **Demand:** The desire for G&S as a function of price
- **Free Market:** Transactions are by mutual consent
- **Perfect Market:** A free market with perfect competition and perfect information
- **Controlled Market:** Government manages important sectors of the economy
- **Mixed Economy:** Imperfect and partly controlled. Most 21st Century economies are mixed.
- How does this supply and demand stuff work, anyway?



In Elastic Demand on price, the quantity demanded increases a lot after a small decrease in price



In Inelastic Demand on price, the quantity demanded doesn't increase much after a decrease in price?

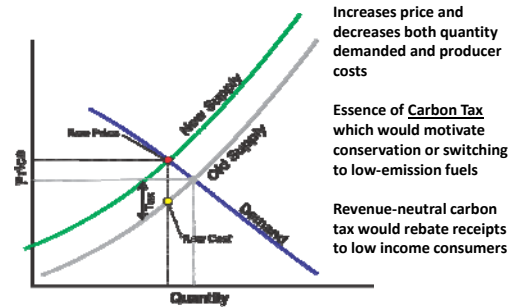


How Do Governments Affect Markets?

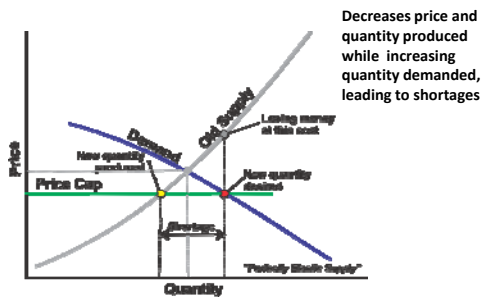
- Taxes, either on fuels or emissions
 - Reduce quantity demanded or promote untaxed alternatives (e.g., Carbon Tax)
- Price caps or supports
 - Often lead to shortages or surpluses
- Quotas or permits
 - Lead to shortages or high prices
 - Can be used to decrease use of an undesirable item
- Cap and Trade imposes Quotas with marketable permits for GHG emissions



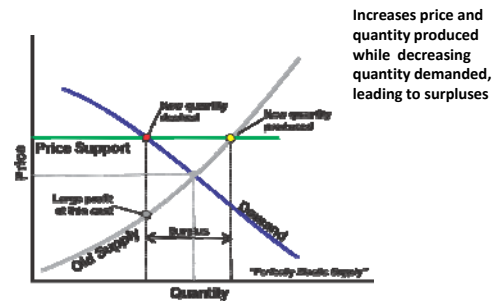
Effect of a Tax on Producers

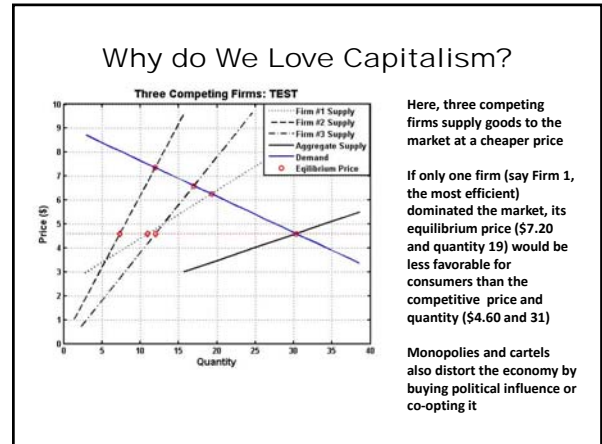
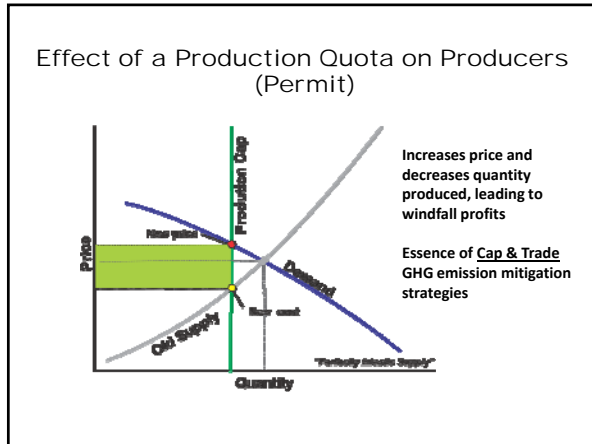


Effect of a Price Cap on Producers



Effect of a Price Support on Producers





How Do Markets Fail?

- Divergent national interests—tariffs, subsidies, ...
- Monopolies and cartels
- Overuse of free or public goods
- Asset bubbles. Boom & collapse
- Incomplete information
- Capitalism works on a timescale of a few weeks to a few years. Climate change on a timescale of decades to centuries

Dorothea Lange: Migrant mother

Marginal Cost

- **Marginal Cost** of another kWh is the direct cost plus the (usually positive) effect on cost of operations
- **Marginal Revenue** is the price paid for that kWh plus the result of driving down prices generally
- A firm is most profitable when marginal cost equals marginal revenue
- The figure at the right shows how marginal costs increase as German electric companies respond to greater demand
- Since electricity can't be stored power companies buy it in the **Spot Market**, where it is often expensive

How to Control Demand for Electricity?

- Rationing by blackouts and brownouts.
 - Maintain service to hospitals, emergency services, etc.
- Priority Pricing: Raise prices during peak demand
- Can be a way to compensate for intermittency of renewable sources

How to Price Mitigation Costs?

- Ideally one would want spending on mitigation to equal the cost of remaining unmitigated AGW
- Optimization just as a market does
- Except that the people who pay and those who benefit are not the same
- This situation is an example of an **Externality**, in which the buyer or seller doesn't bear the full cost.
- Actually low GHG concentrations are **Free Goods** because there is no way to charge for their use

More Definitions

- A good is **Rivalous** if one person's consuming it denies it to another
 - Ice cream cone
- A good is **Excludable** if it is possible to deny it to customers who don't pay
 - Film in an enclosed theater
- A **Public Good** is both non-rivalous and non-excludable
 - Outdoor fireworks display
- An individual who uses a good without paying is called a **Free Rider**
 - Family watching publicly funded fireworks in a locale where they don't pay taxes



The Tragedy of the Commons

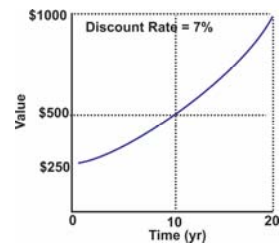


GLOBAL CLIMATE CHANGE, Figure 10.12

Risk and Uncertainty

- In **Risk**, the planner know the odds and necessarily takes calculated risks (known unknowns)
- In **Uncertainty**, the odds, or even the range of possibilities, are unknown (unknown unknowns)
- Climate projections are, of necessity, both risky and uncertain
- So is life...
- It's the unknown unknowns that bite you in the backside

Time Value of Money



- Money now is worth more than money later
- At 7% interest money doubles every ten years
- Thus, \$500 in 2027 is worth no more than \$250 in 2017
- Or, \$1000 in 2034 is equivalent to the same \$250 now
- Here 7% is the **Discount Rate** used to assess whether a future payoff is worth investing 2017 dollars
- Remember the rule of 70:
 - 70/Rate = Doubling time

"Intangible" factors

- Aesthetics or **Hedonic Pricing**: People will pay to live in beautiful (or at least not ugly) surroundings
- **Value of a Statistical Life**, \$5-10M, or maybe \$12M)
- Quality adjusted year of life—used in medicine
- How much are you willing to pay now to keep your grandchildren from living in a **Post-Apocalyptic Dystopia**?
- What are the risks and uncertainties of that happening if we adopt a "Don't worry be happy attitude?"

SUMMARY

- Free (or mixed) markets allocate capital and distribute many goods and services efficiently
- They fail to deal with Climate Change because of:
 - National and corporate free riders
 - Tragedy of the commons, since low GHG concentrations are public goods
- Projects to limit GHG emissions face challenges
 - Established economic interests, often of cartels
 - Risk, and more importantly, uncertainty
 - Time value of money
 - Decades to centuries timescale
- Governmental regulations seem to be the only way to overcome these challenges
 - Cap & Trade and Carbon Tax are two ways to motivate conservation and use of low-emission fuels