More on Externalities
Markets in Pollution Permits
Pollution Permits

- Marketable pollution permits can accomplish same effects as pollution tax.
- Government issues a fixed number of pollution permits.
- Firms are allowed to produce only the amount of pollution allowed by their permits.
- Permits can be bought and sold.
Real-world Examples

- *U.S. Clean Air Act* (1990) tradeable emissions permits established to reduce emissions of \( \text{SO}_2 \) from power plants to half their 1980 levels.
  - Motivation: to control acid rain.
  - Firms got tradeable permits proportional to their historic production.
  - Effects: Plants installed scrubbers in smokestacks, substituted low sulphur for high sulphur coal.
  - Costs lower than expected, more substitution of low sulphur coal than expected.
  - Trading price of \( \text{SO}_2 \) about half what was expected. (about $150 per ton)
Real-world Examples II

- Southern California’s *Regional Clean Air Incentives Market (RECLAIM)* (1994)
  - Motivation: to improve air quality by reducing sulphur dioxide and nitrogen oxides.
  - Stationary pollution sources given tradeable permits proportional to their historic pollution production. Allowable emissions to decrease by 5%-8% per year for the next decade.
  - Effects: A great variety. Some plants installed pollution control equipment, some switched fuel, some changed production processes, some heavy polluters sold their permits and moved out of the area.
– Superior to more specific controls since firms have incentive to find the cheapest way to reduce output of pollution.
Pollution Permit Markets

- The pollution permit market and the final goods market interact to determine price of permits and price of goods simultaneously.

- To know how much a permit is worth to her, a seller must know the price she can expect for a unit of final goods.

- But the supply curve for final goods, and hence the market equilibrium price of final goods, depends on the price of permits.

- You solved this problem in the experimental market.

- Figure 1 shows the outcome with a $20 sales tax for the example of the previous lecture.
Figure 1: Externalities and a Sales Tax
The Price of Lawn Ornaments

- To duplicate effect of the $20 tax with marketable permits we need to issue 12 permits.

- If the number of permits issued is 12, the supply curve of lawn ornaments has to be a vertical line at quantity 12.

- Then the equilibrium price range for lawn ornaments is found in Figure 2. This range is $30-$35.

- For simplicity assume that lawn ornaments sell at midpoint of this range, $32.50.
Figure 2: Lawn Ornament Market with 12 permits

Price of Lawn Ornaments vs Number of Lawn Ornaments
Equilibrium Price of Permits

- We need to find the demand curve and supply curve for permits.

- The supply curve is vertical at 12, since exactly 12 permits are issued.

- What about the demand curve? The demanders for permits are suppliers of lawn ornaments, who need them in order to sell ornaments.

- Suppliers know they can sell a lawn ornament for $32.50.

- A supplier with SC of $8 will not buy a permit if it costs more than $24.50, but will buy for less.
• Similarly, sellers with SC of $13 will pay up to $19.50 for a permit, sellers with SC of $18 will pay up to $14.50, and so on.

• Supply and demand curves are shown in Figure 3.

• Equilibrium price of permits is in range from $15-$20.
Figure 3: Supply and Demand Permits—($P_{LO} = $32.50$)
A Positive Externality: Example

- A town has 100 families and 100 old houses, all of which could use a paint job.

- Buyer Values for painting one’s own house are as follows:
  - 50 families have BV of $800.
  - 30 families have BV of $400.
  - 20 have BV of $100.

- Each person experiences a benefit worth $2 from every other person’s house that is painted.

- The supply curve of paint jobs is horizontal at a price of $500.
Figure 4: Subsidizing House Painters

Price (in $100)

Number of Houses
Effect of a Subsidy

- The total external benefits from a family’s paint job is $2 \times 100 = $200

- A $200 subsidy paid to house painters for each paint job done will shift supply curve down by $200.

- The effect is show in Figure 4. Price falls to $300. Number of houses painted increases to 80.

- Total cost of the subsidy to painters is $80 \times $200 = $16,000.

- Government pays for this subsidy by collecting $16,000/100 = $160 from each citizen.

- Each citizen gets an external benefit of $80 \times 2 = $160 from the fact that 80 houses are painted.
Total Profits with 3 Options

Detailed calculations of these results are found in the last 3 slides of this lecture.

- Total profits of all families in town can be calculated for the following three cases.
  - No Intervention—$25,000
  - Everyone is required to paint their house—$26,000
  - A $200 subsidy is paid to house painters for each house painted—$28,000

- Question: What would be the effect of a $200 subsidy paid to every family that had its house painted?
How the types rank options

Detailed calculations leading to these results are found in the last 3 slides of this lecture.

- $800$ BV types like the subsidy and required painting equally well and prefer both to no intervention.

- The $400$ BV types like the subsidy best, required painting second, and no intervention least.

- The $200$ BV types like no intervention best, the subsidy second, and required painting least.
Total Profits with no Intervention

- The 50 families with $800 BV paint their houses. The other families do not.
  - Those who paint each gain a profit of $800 – $500 from doing so.
  - Not accounting for externalities, total profits are $300 × 50 = $15,000.
  - Total value of positive externalities for each family is $2 × 50 = $100. Since 100 families get this benefit, total value of positive externalities is $100 × 100 = $10,000.
- Adding the profits from positive externalities to the profits made by those who painted their own houses, total profits are $15,000 + $10,000 = $25,000.
Total Profits if Painting Required for All

- If all must paint their houses, then 100 houses are painted, so everybody gets external benefits of $2 \times 100 = $200.

- The 50 families with $800 BV each make a profit of $800 - $500 = 300 on painting their own house plus $200 external benefits for a total of $500 per family. Total profits for these 50 families is $50 \times 500 = $25,000.

- The 30 families with $400 BV each have a loss of $400 - $500 = -$100 from painting their houses. They get external benefits of $200, so each has a profit $200 - $100 = $100. Total profits for these 30 families is $30 \times $100 = $3000.

- The 20 families with $200 BV each have losses of
$200 - $500 = -$300 from painting their own house. They get external benefits of $200 each, so each has a net loss of $200 - $300 = -$100. Total loss for these 20 families is $20 \times 100 = $2000.

• The grand total of profits for all 100 persons is therefore $25,000 + $3000 - $2000 = $26,000.
**Total Profits with $200 Subsidy**

- With the subsidy, 80 houses are painted, so everybody gets external benefits of $2 \times 80 = $160. Everybody pays taxes of ($200 \times 80)/100 = $160. These two effects just net out for each person, so total profits of each type are equal to the profits they make from buying their own paint jobs at the subsidized price.

- The $800 BV families buy a paint job for $300. They each get profits of $800 - $300 = $500. There are 50 of these families. Their total profit is $500 \times 50 = $25,000.

- The $400 BV families buy paint jobs of $300 and each makes a profit of $100. There are 30 of these families. Their total profit is $100 \times 30 = $3000.
• the $200 BV families don’t buy paint jobs. They make no profits. (Remember that the externality gain that they get is just cancelled by their taxes.)

• The grand total of profits for the 100 persons is $25,000 + $3,000 + 0 = $28,000.