Lecture # 7 – Emission Fees

I. Emission Fees

- Recall that the problem with externalities is that they are not reflected in prices.
  - The government can rectify the problem by setting a price for pollution.
  - The goal is to set the fee so that the polluter incorporates the social cost.
- If MAC is known, simply set the fee equal to MAC at the optimal level of pollution.
  - The firm will find it beneficial to abate up to this point, since abating is cheaper than paying the fee.
  - After this point, paying the tax is cheaper than abatement, so no further abatement occurs.
  - Note that since MAC = MD at the optimal level, the firm is taking into account the value of the damage it is doing.
  - If MAC is unknown, the fee should be based on the expected value (the "best guess" of MAC).
- The main advantage of emissions fees is that, when there is more than one polluter, they achieve a given level of pollution control at the lowest possible cost.
  - Thus, economists say that emissions fees are an efficient environmental policy.
  - An efficient solution is found when the marginal abatement costs are equal across all firms.
    - At this point, there is no way to shift abatement responsibilities among the firms and achieve a lower total cost.
    - However, the cost to each individual firm is greater, since the firms pay both abatement costs and the fees.
    - Thus, emissions fees are politically unpopular.

Source A				*Source B*			
Emissions	Abatement	MC	TC	Emissions	Abatement	MC	TC
12	0	0	0	12	0	0	0
11	1	1,000	1,000	11	1	2,000	2,000
10	2	2,000	3,000	10	2	4,000	6,000
9	3	3,000	6,000	9	3	6,000	12,000
8	4	4,000	10,000	8	4	10,000	22,000
7	5	5,000	15,000	7	5	14,000	36,000
6	6	6,000	21,000	6	6	20,000	56,000
5	7	8,000	29,000	5	7	25,000	81,000
4	8	10,000	39,000	4	8	31,000	112,000
3	9	14,000	53,000	3	9	38,000	150,000
2	10	24,000	77,000	2	10	58,000	208,000
1	11	38,000	115,000	1	11	94,000	302,000
0	12	70,000	185,000	0	12	160,000	462,000

Goal: Reduce pollution by 12 units

Command and Control: Each firm reduces by 6 units

	Abatement Costs
Source A	21,000
Source B	56,000
Total Cost:	77,000

Emissions Fee: $10,000 per ton

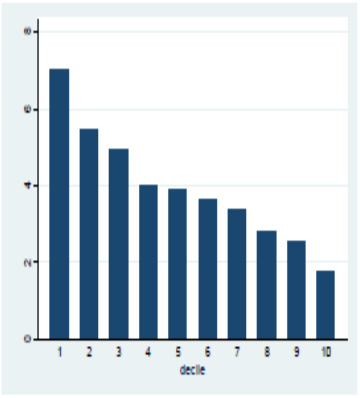
	Abatement Costs	Tax bill	Total Payments
Source A	39,000	40,000	79,000
Source B	22,000	80,000	102,000
Total Cost:	61,000	120,000	181,000

LESSON: ***Tax equates MAC across firms. Therefore, it achieves the pollution control target at minimum cost.***

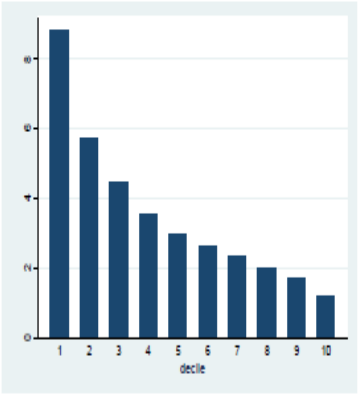
- An important consideration for policy makers is how different groups are affected by taxes.
    - How is burden measured?
        - Burden of a tax is the impact on household welfare, measured in dollars
            - Relates to tax incidence: depends on elasticity of supply and demand
        - Progressive if burden per dollar of a taxpayer's income rises as income rises
        - Regressive if burden per dollar of a taxpayer's income falls as income rises
- Examples of policy incidence
    - Pizer and Sexton (2019), look at consumption patterns by total household expenditure decile (vertical equity)
        - For electricity, shares of consumption are higher for lower expenditure households
        - For gasoline, taxes are less regressive
            - In Mexico, higher expenditure families spend more on gasoline

Figure 2: Average Electricity and Motor Fuels Expenditures as Percent of Total Spending for U.S., U.K. and Mexico Households by Expenditure Decile

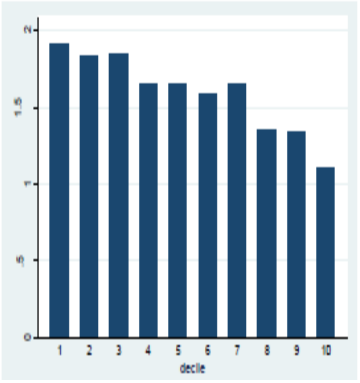
Panel A: Electricity: USA



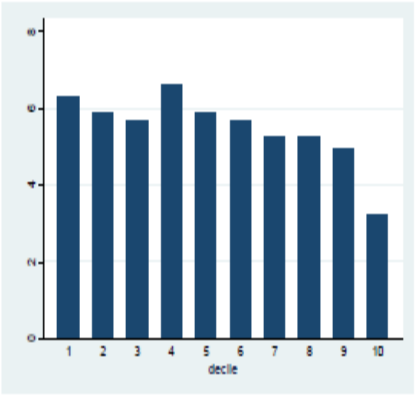
Panel B: Electricity: U.K.



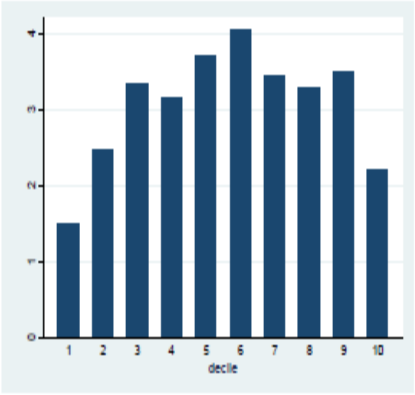
Panel C: Electricity: Mexico



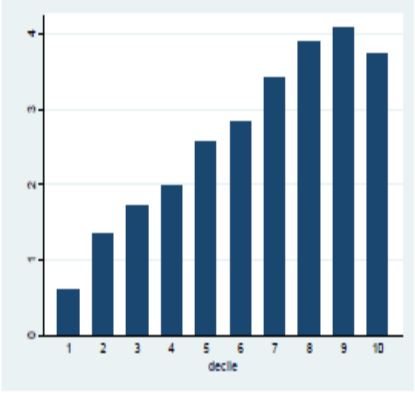
Panel D: Motor fuels: U.S.



Panel E: Motor fuels: U.K.



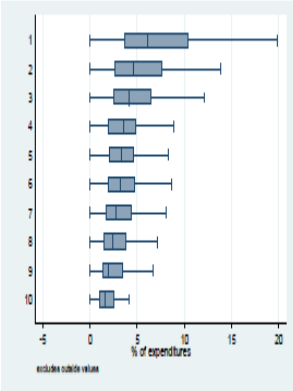
Panel F: Motor Fuels: Mexico



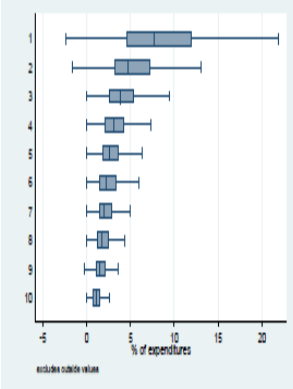
- Looking at horizontal equity (variation within expenditure deciles), there is more variation for lower income households

Figure 4: Intra-class variation in electricity and gasoline expenditures by total expenditure decile. *For each decile (1 = poorest, 10 = richest), the blue shaded box shows the interquartile range (IQR) with the median indicated by a line; the whiskers show the range of values within 1.5 times the IQR on either side of the box..*

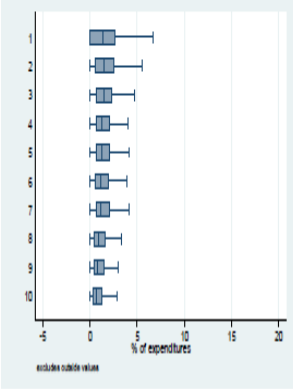
Panel A: Electricity: USA



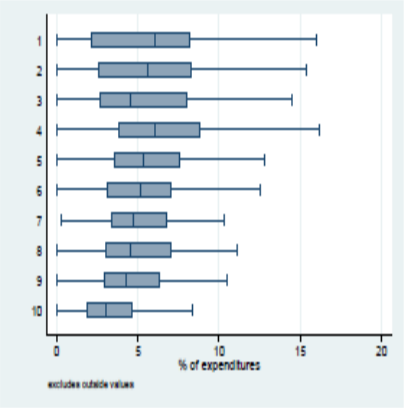
Panel B: Electricity: U.K.



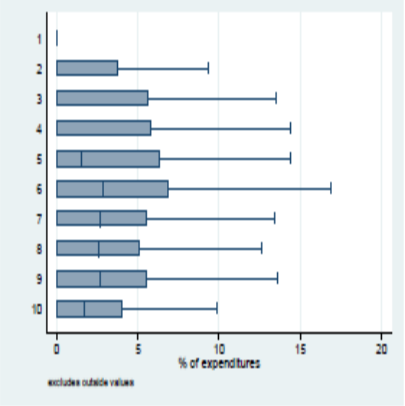
Panel C: Electricity: Mexico



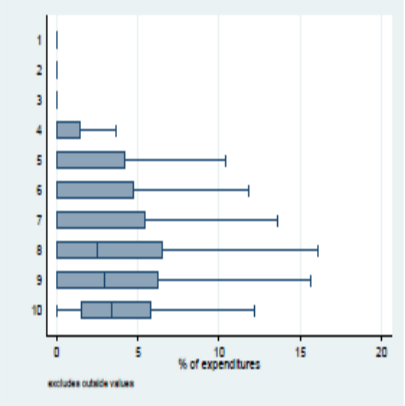
Panel D: Gasoline: USA



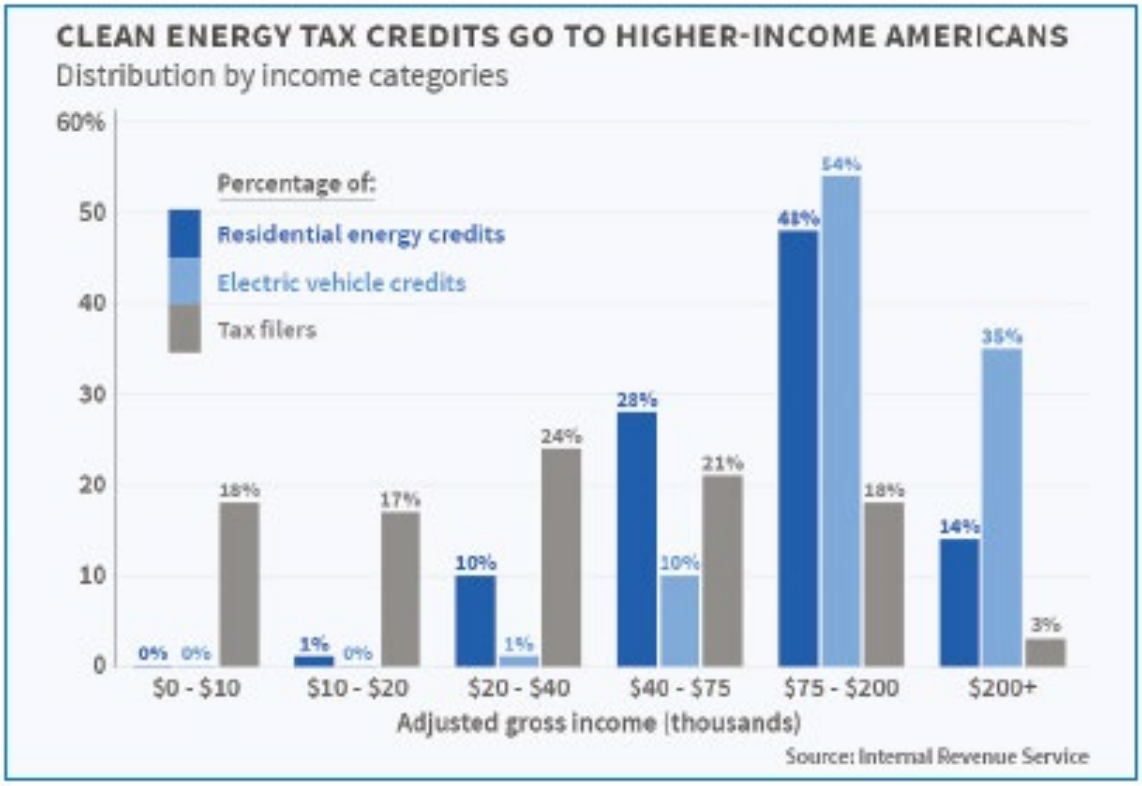
Panel E: Gasoline: U.K.



Panel F: Gasoline: Mexico



- Tax expenditures
  - Reductions in taxes using tax credits and subsidies
  - Examples
    - Tax credits for home weatherization, EV purchase, and solar panels
      - Benefits go to higher income families
        - Taxpayers with income above $75,000 receive 60% of all credit dollars aimed at energy efficiency, residential solar, and electric vehicles
        - Would some of these people bought the product anyway?

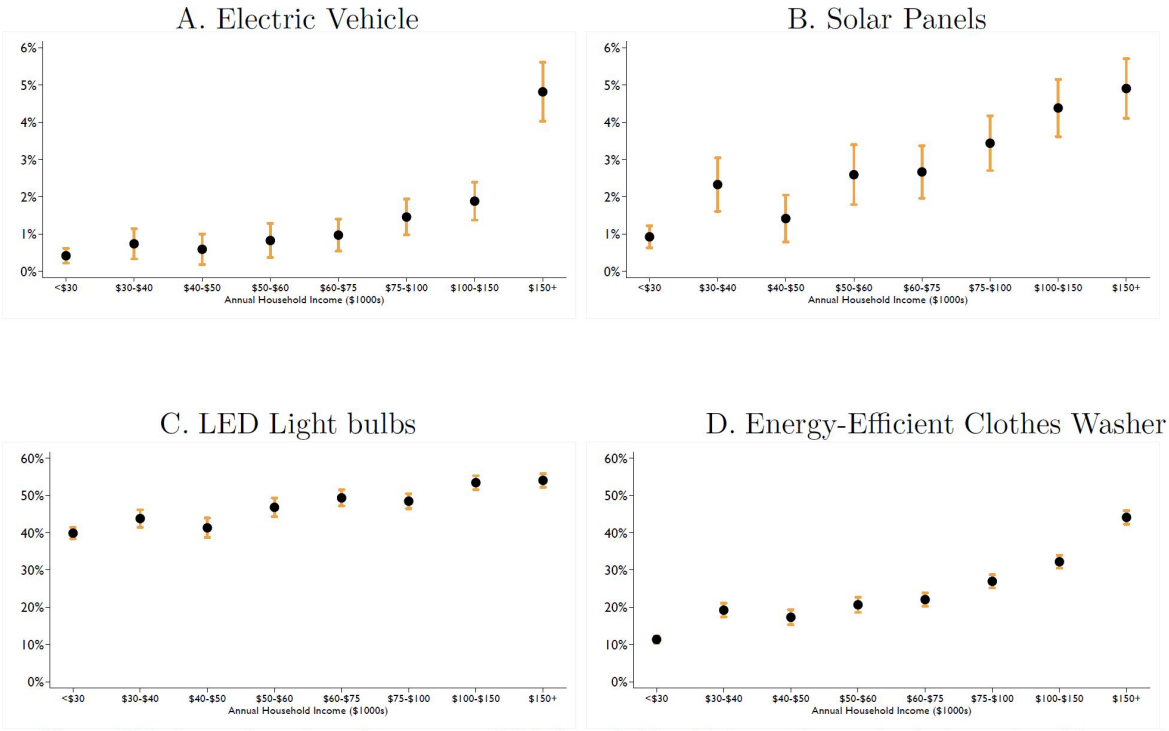


Source: [NBER Digest, September 2015]

- Some of the benefits of solar credits go to solar panel vendors
  - Advent of leasing helps lower income families benefit from the credit as well

- High-income households are more likely to adopt most low-carbon technologies (Davis, *NBER Working Paper 31344*, 2023).
  - High-income families more likely to purchase equipment
  - Most credits are non-refundable. Many households in lowest income brackets pay no federal income tax

Figure 2: Adoption of Other Low-Carbon Technologies, By Household Income



Note: This figure shows how the percent of U.S. households with low-carbon technologies varies with annual household income. These data come from the U.S. Department of Energy, *Residential Energy Consumption Survey 2020*. Brackets indicate 95 percent confidence intervals. LED light bulbs is defined as having "mostly" or "all" LEDs. Energy-efficient clothes washers are defined as being front-loading rather than top-loading.

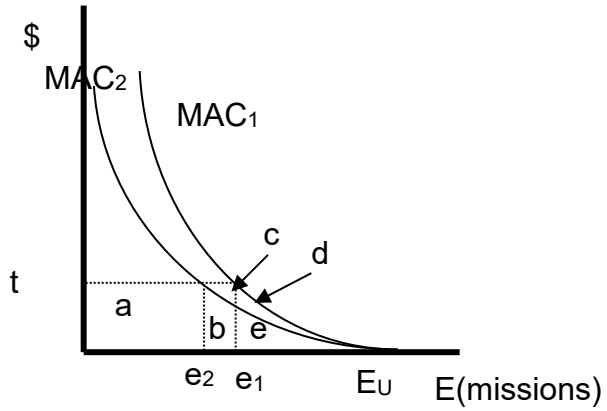
- Carbon tax
  - Need not be regressive
    - Use of revenue matters
  - A Tax Policy Center study on implementing a carbon tax provides an example of how the use of revenue matters
    - Figure 2 (next page) shows that a carbon tax itself (graph on left) is regressive
    - Lowest income quantile spends a larger percentage of its income
  - How the revenue is used (discussed more later in class) can change this
    - Refundable credits help poor families more
    - Lower personal or corporate taxes help higher income families (graphs on right -- % of income going to taxes falls for lowest quantiles with a credit, for example)

Figure 2. The Distributional Effects of a Carbon Tax, Recycling Options, and Revenue-Neutral Tax Plans

These charts show how the impact of tax options varies by income. Households are arranged from lowest to highest income in five groups ("quintiles"), with impacts measured as a percent of pre-tax income. These figures illustrate a $20 per ton tax in 2015; impacts would scale proportionally for higher or lower tax rates.

Source: Urban-Brookings Tax Policy Center Microsimulation Model.

- Another potential advantage of fees over CAC is that fees encourage innovation.
  - Once you've met a CAC regulation, you have little incentive to do better.
  - However, if you lower your MAC, you can abate more and pay less in fees.



  - Consider a tax equal to t
    - With MAC_1, e_1 is the level of emissions.
      - Abatement costs = d + e
      - Tax bill = a + b + c
        - Total cost to firm: a + b + c + d + e
    - With MAC_2, e_2 is the level of emissions
      - Abatement costs = b + e
      - Tax bill = a
        - Total cost to firm: a + b + e
    - Savings: c + d
  - Under command and control regulation, there is no incentive to reduce emissions to e_2, even when MAC are lower
    - Instead of d + e, the cost of abatement falls to e (because emissions remain at e_1).
    - Cost savings under CAC regulation: d
  - Key point: savings from new MAC are greater with emissions fee. Therefore, the rewards for doing R&D to lower MAC are greater.

- Disadvantages of taxes and emission fees
    - Uncertainty
        - Compared to command and control, emission fees provide more certainty on costs, but less certainty on the final level of emissions.
    - Geographically-varying damage (Note that this didn't come up in the discussion in class, but it is important. We'll discuss this again on cap-and-trade).
        - Market-based policies guarantee an overall goal, but they don't guarantee which firms will reduce and which firms won't. If firms near an urban center choose to pay the fee rather than reduce emissions, damages may remain high.
            - Varying the fee based on potential damages can help address this.
    - Monitoring costs
        - To charge a fee per unit of pollution, all pollution must be monitored and measured.
    - Less popular politically
        - Firms have a higher tax bill
        - All new taxes unpopular in the U.S.
    - Distributional issues
        - Concerns about equity might make some environmental taxes politically unpopular. For example, lower income families spend more of their income on gasoline, making a gas tax a regressive.
        - While all policies raise the possibility of costs being passed on to consumers, there are more costs to be passed on here, as firms pay both for abatement and the fee for the remaining units of pollution.

II. Implementation Issues

- Questions for designing an environmental excise tax:
    1. What is to be taxed?
        - That is, what is the tax base?
            - May be direct (e.g. CFCs, emissions), or indirect (e.g. gasoline)
        - Could also use a multi-part tax: tax sale of an indirect commodity and subsidize clean technology to encourage people to change behavior
            - E.g. tax fuel and subsidize fuel efficient cars to encourage people to buy more efficient cars, since cannot tax emissions from vehicles directly
        - Administrative costs are part of this decision
            - Want to tax users directly
            - However, it may be difficult to know the users
            - May be easier to tax production rather than users.
                - Emissions come from vehicles, electricity production, airplanes, industry, agriculture, etc.
                - Emissions not easily monitored, so likely would tax fuel
                    - A carbon tax on fuel captures emissions from combustion, but ignores processes like cement manufacturing or land use.
                    - Doesn't reward processes such as carbon capture and storage.
    2. What tax rate to impose?
        - This is where most of the economic analysis comes in.
            - In principle, the tax should reflect marginal damages
            - But knowing MD is difficult
            - Other options (using carbon taxes as an example):
                - Calibrate tax path to hit specified emissions targets (e.g. 2^{o} warming)
                - Choose a level that is politically feasible that can be adjusted later.
        - Although we also might not know about MAC, taxes may help us learn about the MAC of firms.
            - They will choose to pay the tax when tax < MAC.
            - Thus, while we might not be able to determine where MD=MAC, we can get a cost-effective allocation of abatement for a given target without needing to know MAC

3. How are the revenues used?
    - Existing taxes affect possibility of double dividend: improving overall efficiency of the tax system by using revenue to lower other taxes.
    - Typical policy options for cutting taxes
        - Lump sum payments could improve equity
            - Equal transfers could give low-income households back more money than they pay in taxes
        - Reducing capital taxes
            - Generally improves long-run efficiency
        - Reducing labor taxes
            - Studies generally find this less efficient
    - Revenue use can help political acceptability of a carbon tax (Klemert *et al*., *Nature Climate Change*, 2018)

III. Examples

- Carbon tax examples
    - British Columbia enacted a carbon tax in 2008
        - Ended April 1, 2025 after Canada removed requirements for provinces to have consumer-facing carbon price
        - Covered GHG from fossil fuels
            - Exemptions for greenhouse growers established in 2012 over concerns they were uncompetitive with California and Mexico
        - Broad scope
            - Covers 70-75% of BC GHG emissions
        - Sends a strong price signal
            - Tax rate started at $10 Canadian, reached $30 Canadian in 2012, $80 by 2024.
        - Use of revenues
            - Revenue-neutral
            - BC Ministry of Finance must file an annual report showing how revenues are used. The report is reviewed by the BC legislature.
            - At first, most revenue lowered corporate and personal income taxes
            - More recently, revenue goes to targeted tax cuts in particular sectors (including motion pictures!)
            - Thus, it is becoming more political
        - Effects:
            - Reduced gasoline and natural gas consumption
            - Studies suggest roughly 5-20% reduction in emissions, although not in all sectors
            - Net employment effects small: jobs lost in emission-intensive manufacturing offset by service sector job increases
            - Targeted rebates give lowest income households more back than they pay in

- Other examples of environmental taxes
  - Environmental taxes are a small share of revenue in most countries
  - On average, made up 4% of tax revenue in OECD countries in 2022
  - Overall, most environmental taxes focus on air pollution, particularly energy consumption
    - About 2/3 of revenues from environmental taxes come from fuel taxes
    - But, in many countries, fuel taxes are more like a user fee than a Pigouvian tax.
      - The federal gas tax is essentially a user fee, since revenues go into the Highway Trust Fund
      - Reducing pollution is not a goal of the federal gas tax.
    - Parry (2014) shows that taxes in many countries below the level needed to cover social costs
      - Exceptions include Brazil, Germany, Israel, UK
    - Vehicle taxes in some countries consider environmental impact
      - Vehicle taxes in Norway depend on a vehicle's CO2 emissions per km, weight, and engine power