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.

Firm 1				*Firm 2*			
Emissions	Abatement	MC	TC	Emissions	Abatement	MC	TC
10	0	0	0	10	0	0	0
9	1	2.5	2.5	9	1	0.625	0.625
8	2	5	7.5	8	2	1.25	1.875
7	3	7.5	15	7	3	1.875	3.75
6	4	10	25	6	4	2.5	6.25
5	5	12.5	37.5	5	5	3.125	9.375
4	6	15	52.5	4	6	3.75	13.125
3	7	17.5	70	3	7	4.375	17.5
2	8	20	90	2	8	5	22.5
1	9	22.5	112.5	1	9	5.625	28.125
0	10	25	137.5	0	10	6.25	34.375

Goal: Reduce pollution by 10 units

Command and Control*: Each firm reduces by 5 units*

	Abatement Costs
Firm 1	37.5
Firm 2	9.375
Total Costs:	46.875

Emissions Fee*: $5 per ton*

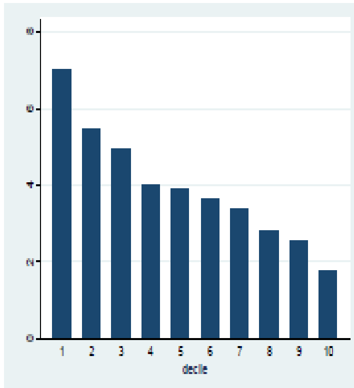
	Abatement Costs	Tax bill	Total Payments
Firm 1	7.5	40	47.5
Firm 2	22.5	10	32.5
Total Cost	30	50	80

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

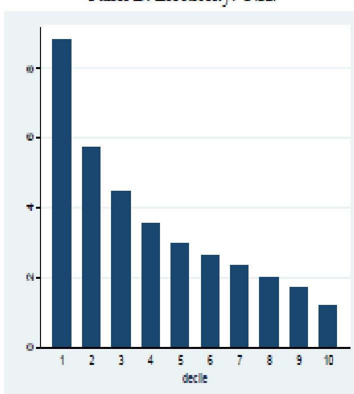
- An important consideration for policy makers is how different groups are affected by taxes.
    - How is burden measured?
        - Burden of a tax is the impact on household welfare, measured in dollars
            - Relates to tax incidence: depends on elasticity of supply and demand
        - Progressive 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

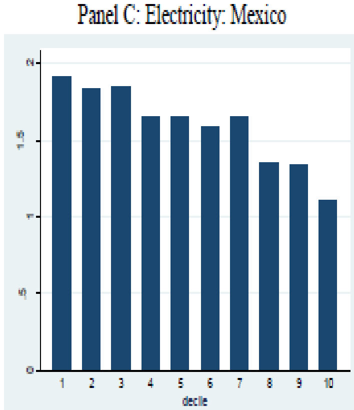
Panel A: Electricity: USA



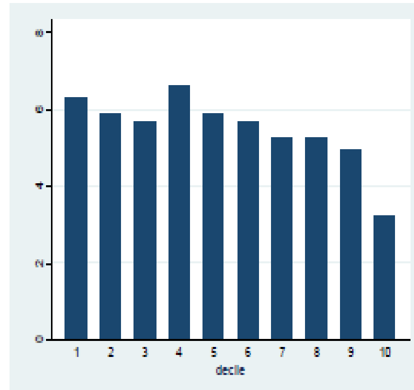
Panel B: Electricity: U.K.



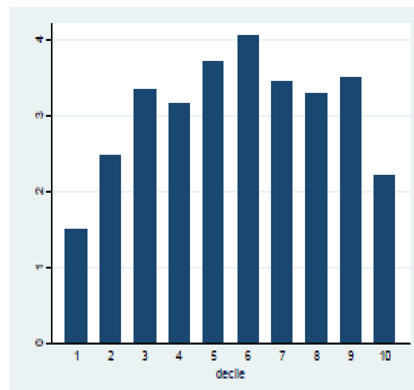
Panel C: Electricity: Mexico



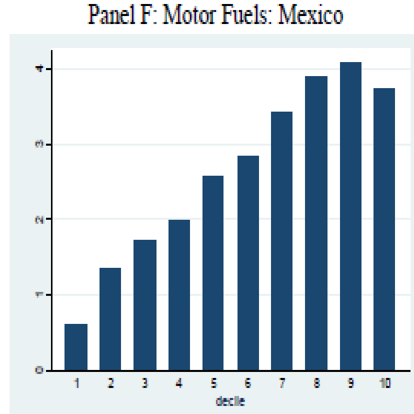
Panel D: Motor fuels: U.S.



Panel E: Motor fuels: U.K.



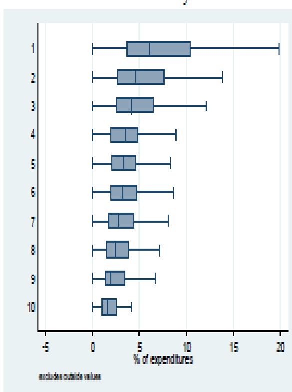
Panel F: Motor Fuels: Mexico



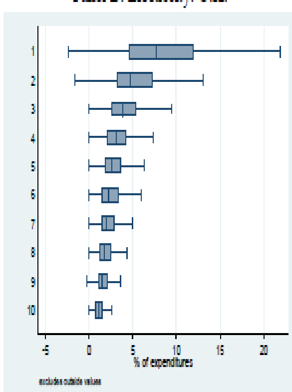
- Looking at horizontal equity (variation within expenditure deciles), there is more variation for lower income households

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..*

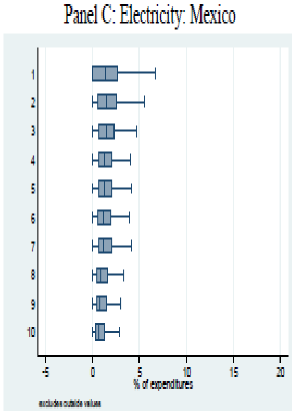
Panel A: Electricity: USA



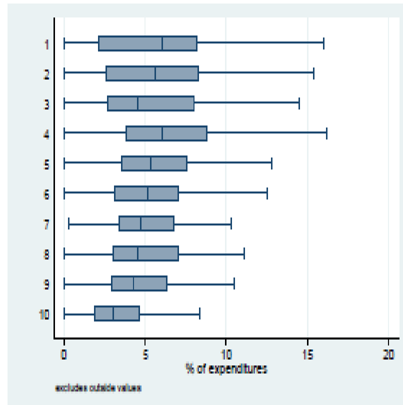
Panel B: Electricity: U.K.



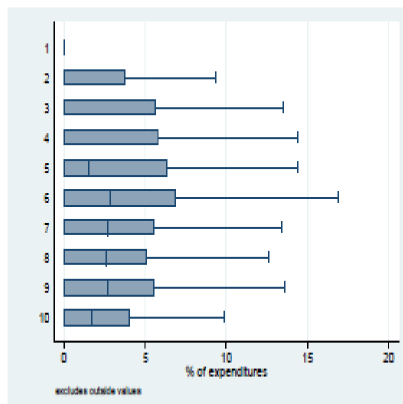
Panel C: Electricity: Mexico



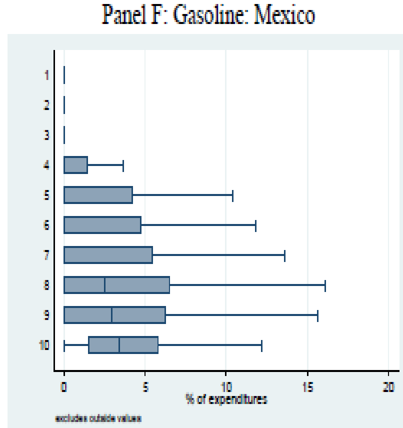
Panel D: Gasoline: USA



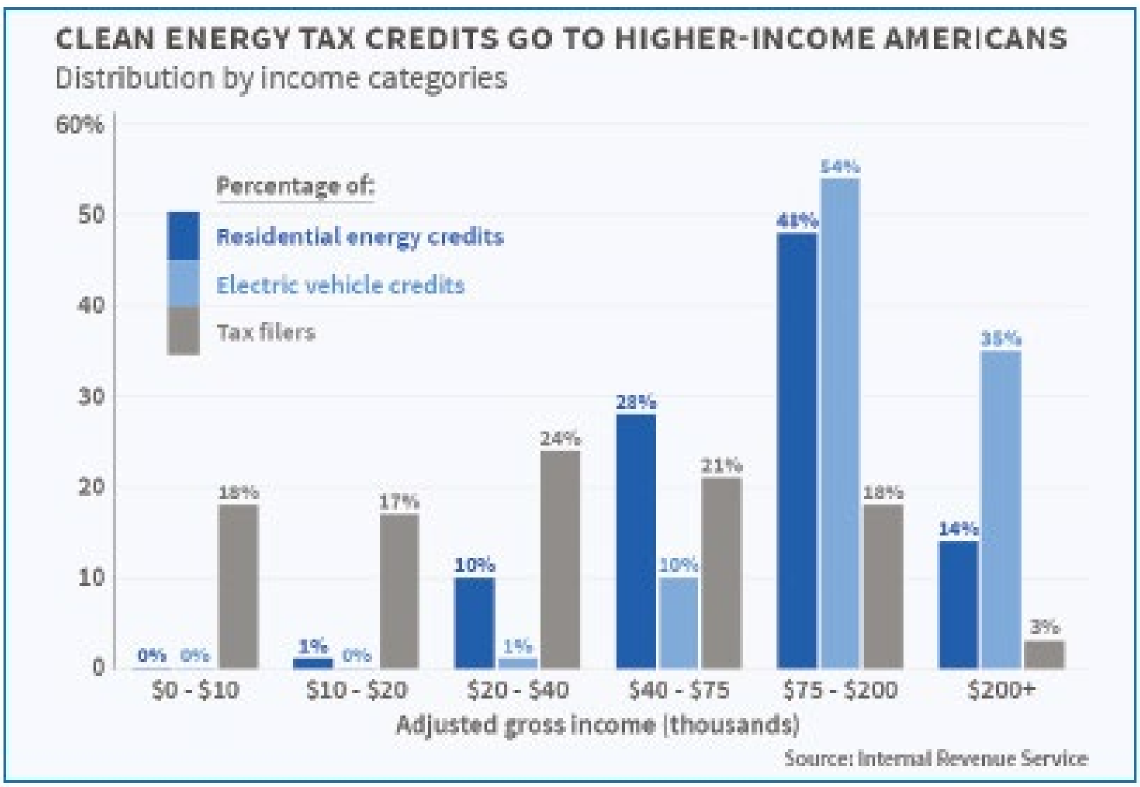
Panel E: Gasoline: U.K.



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?



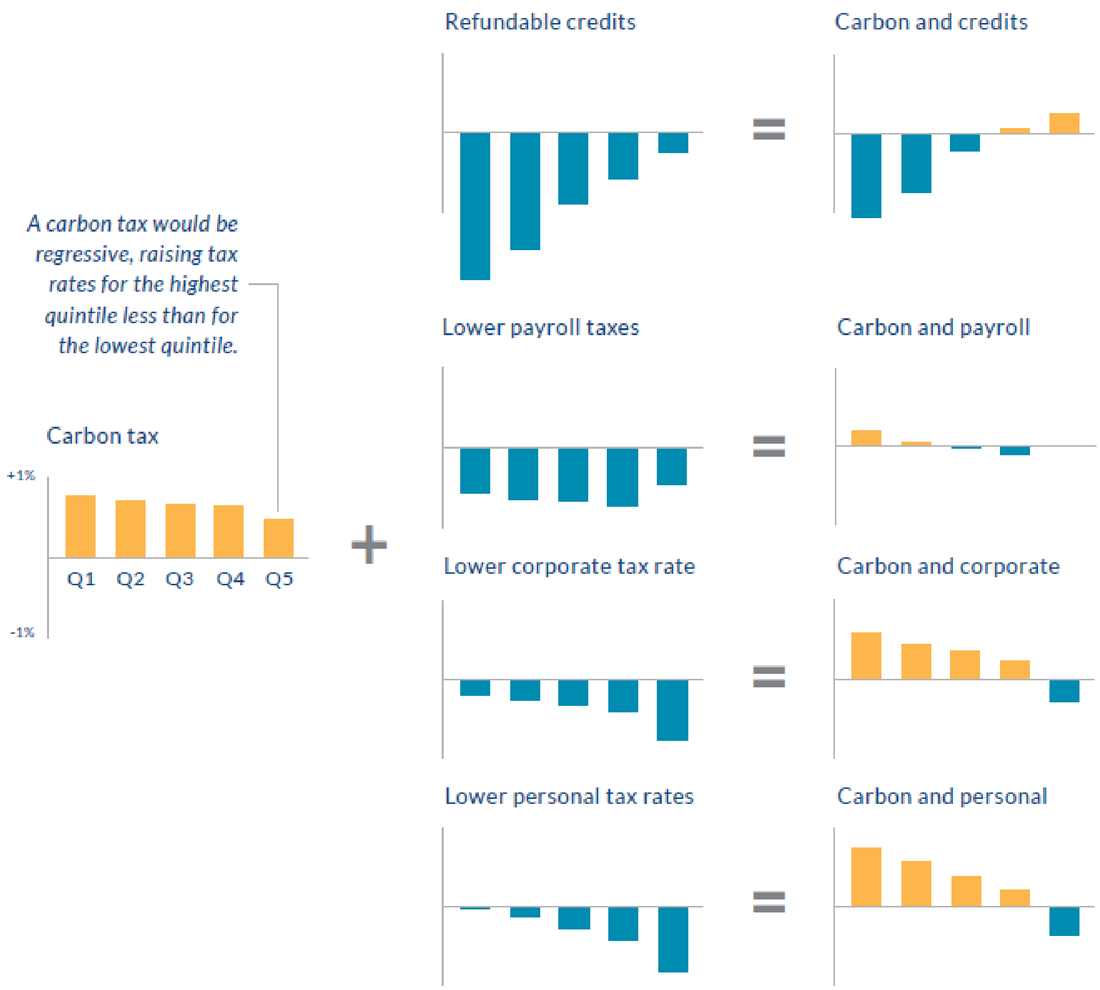
Source: [NBER Digest, September 2015]

        - 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

- Carbon tax
  - Need not be regressive
    - Use of revenue matters
  - The reading 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.
        - See, for example, figure 12-7 in Field.
- 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:
    - 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
        - There may be many users.
            - For CFCs, it was easier to tax production than tax each user.
            - Consider example of taxing CO2 emissions from the reading:
                - 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.
        - Also need to consider other greenhouse gases, such as methane.

    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 (from carbon tax paper):
                - 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. Are their ancillary policy goals?
    - Taxes are not enacted in a policy vacuum.
    - Multiple goals often conflict.
        - For example, exports are exempt from the ozone depletion tax, so that US exports are not at a disadvantage compared to products from countries without the tax.
        - This conflicts with environmental goals.
            - Environmentally, CFC is a global pollutant, so where the CFC is shouldn't matter.
    - Common conflict: revenue vs. abatement
        - Taxes are a source of revenue.
        - If an environmental tax is successful, it lowers emissions, thus lowering the tax base.
        - Therefore, if revenues are important, we might adjust the rate.

- The paper by Klenert *et al*. discusses how revenues raised can alter political acceptability of a carbon tax.
    - Number of carbon pricing initiatives is growing
        - Over 70 national or subnational programs at time of publication
        - Climate Pricing Leadership Coalition suggests a carbon price of $40-80/ton by 2020 and $50-$100/ton by 2030 to meet Paris Agreement goals
            - Only 20% of current programs are at this level
            - Thus, increases are needed
    - Policy design affects political acceptability
    - What matters politically?
        - distributional fairness
        - revenue salience
        - political trust
        - policy stability
    - Article discusses lessons from public economics, behavioral economics, and political science.

- Lessons from public economics
  - Public economics informs what is good policy design
  - Existing taxes affect possibility of double dividend: improving overall efficiency of the tax system by using revenue to lower other taxes
  - Three policy options
    - Lump sum payments improve equity
      - Equal transfers could give low-income households back more money than they pay in taxes
      - But may be less efficient
        - Results depend on assumptions about whether the existing tax system is optimal. If not, tax reform that moves towards an optimum may be better. Otherwise, lump-sum redistribution preferred
    - Reducing capital taxes
      - Generally improve long run efficiency
    - Reducing labor taxes
      - Studies generally find this less efficient
  - Summary:
    - If tax system is suboptimal, moving closer to the optimum takes precedence
    - But improving efficiency may be less equitable. ***There is a tension between efficiency and equity***
      - Directed transfers to households are more equitable but less efficient if the tax system is inefficient
- Lessons from behavioral economics
  - Should policy instruments address behavioral biases?
  - Four lessons
    - Willingness to accept a carbon tax depends on political, economic, and cultural beliefs?
      - Resistance to carbon tax in US referred to as “solution aversion”: citizens are more skeptical of an environmental problem if the policy solution contradicts their ideological disposition
      - E.g. “anti-tax” movement in US cited by Nordhaus
    - Citizens focus on what revenue would be used for
      - Skeptical if revenue goes to general revenue
      - More acceptable if revenue goes to green investments or targets specific groups.
    - Labeling matters
      - Carbon “fee” more popular than a carbon “tax”
    - Salience of revenue recycling
      - Lump sum transfers are highly visible

- Lessons from political science
    - Political trust
        - Countries with greater public distrust of politicians and perceived corruption have weaker climate policies
    - Concentrate benefits on constituencies likely to actively support the policy's passage and preservation
        - Policy reform more likely to be successful if costs are diffuse and benefits concentrated
        - But carbon pricing has diffuse benefits and concentrated costs
        - Note relation to behavioral economics: *make the benefits more salient*
        - Policy more likely to survive over time if it benefits constituencies across the political spectrum
            - May make returning revenue via lump-sum transfers more politically viable

III. Examples

- Environmental tax examples
    - British Columbia enacted a carbon tax in 2008
        - Covers GHG from fossil fuels
            - Exemptions for greenhouse growers established in 2012 over concerns they were uncompetitive with California and Mexico
        - Covers 70-75% of BC GHG emissions
        - Tax rate started at $10 Canadian, reached $30 Canadian in 2012
        - Effect on emissions
            - Studies suggest roughly 5-15% reduction in emissions
        - Effect on growth
            - Compared to other provinces, no negative effect on BC growth rates
        - 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

- More than 40 governments now use some sort of price on carbon
  - But prices are often low
  - Canada extended carbon pricing to provinces without their own carbon tax or cap-and-trade policy in 2019, but the policy is controversial
    - Starts at $15/ton, rising to $38 by 2022
    - Several key industries exempt due to trade competition
- Figure 3 in Klenert *et al.* summarizes other experiences with carbon revenue
  - Alberta
    - Most goes to green spending
    - Tax is called a "levy"
  - Australia
    - Tax introduced in 2012, dropped in 2014
    - Most revenue went to affected firms
    - Key lesson: efficiency and equity not enough – need to communicate political benefits
  - British Columbia
    - Revenues go back to households and firms
  - Norway
    - Roughly a third each to:
      - Corporate tax cuts
      - Invest in green tech
      - General revenues
  - Switzerland
    - Called a CO2 levy
    - 2/3 goes back to households and firms as a lump-sum transfers
    - 1/3 for green spending
  - Comments:
    - Note that government trust is higher in Sweden and Norway
    - Compare to revenue from carbon trading (as shown in Figure 4)
      - Most revenues go to projects not salient to taxpayers, often as green spending
      - Because firms affected, more focus on helping them (e.g. reducing impacts on trade-impacted firms)
      - Nordhaus says EU-ETS failed because cap and trade depends on forecasting future emissions
        - Price fell because emissions lower than expected
        - *With a carbon tax, price of carbon is independent of emissions*

- 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 CO_2 emissions per km, weight, and engine power
- U.S. tax on ozone-depleting chemicals
    - Passed in 1989 to eliminate chlorofluorocarbons (CFCs) following the Montreal Protocol
    - Production of CFCs is taxed per pound. The tax rate increases over time
- Examples of subsidies in U.S.
    - Tax break for carbon capture and storage
        - Up to $50/ton for CO_2 captured and permanently stored
        - Up to $34/ton for CO_2 captured and used in enhanced oil recovery
    - Brownfield development grants (also include changes in liability law)
    - Tax credits for alternative fuels
        - Hybrid vehicles
        - Residential solar