

The Role of Prices and R&D in Reducing Carbon Dioxide Emissions

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Main Findings

- Two Market Failures → Two Policy Instruments
 - Price carbon emissions to reflect external costs
 - Subsidize R&D to reflect spillover benefits
- Simulation Model Results Indicate Delaying Pricing Would Not Be Cost-Effective
- Given Uncertainty, a Tax, or Cap-Safety Valve Would be More Efficient than a Fixed Cap

Pricing Emissions to Account for External Costs

Tax or cap on carbon → Fossil fuel prices rise

- Changes in behavior and capital equipment
- Increase in R&D
- Gradually rising, world-wide price most efficient
 - Prices reflect PDV of avoided damages

Current Policies:

- Conflicting Incentives with uncertain net effects
- Not comprehensive and not linked to carbon content

Subsidizing R&D to Account for Spillover Benefits

- Absent support, firms invest too little in R&D, even with pricing
 - Spillover benefits greatest for basic research
- Current policies
 - Patent laws
 - Two tax provisions
 - Direct support of R&D on carbon-reducing technologies
- Determining whether current amount and design of R&D is sufficient was beyond the scope
 - Weigh uncertain outcomes against costs
 - Opportunity cost of federal funds
 - Crowding out of other R&D

Simulations of Pricing and R&D Policies

- Three models offer consistent comparisons
- Quantitative results suspect:
 - Uncertain Benefits and Costs
 - Assume policies implemented in an efficient fashion at the global level
 - Models handle distributional effects and thresholds poorly

Simulation Results on Pricing and R&D

- Consistent qualitative outcomes:
 - Delaying pricing would not be consistent with:
 - The goal of maximizing net benefits (benefits – costs) or
 - The goal of minimizing the cost of achieving an emissions target.
 - Subsidizing R&D would not reduce value of near term reductions

More Detail on Simulation Results

- Nordhaus found:
 - Net benefits from R&D less than half those from pricing
 - R&D had no significant impact on efficient near-term prices
 - Did not include backstop technology
- Popp (with backstop technology) found:
 - R&D subsidies had little effect on efficient near-term prices
 - Adding R&D to pricing increased net benefits by 7 percent
 - Qualitative results held even w/no crowding out
- Schneider and Goulder found:
 - Reducing emissions by 15% costs 9x more with R&D subsidy than with a carbon tax
 - Adding R&D subsidy to pricing reduce costs by 9 percent.

Underlying Intuition for Conclusions About Timing

- Cost continuum for emission reductions. Low cost reductions today help minimize costs unless R&D eliminates value of today's reductions.
 - Unlikely given anticipated returns on R&D
- Policies aimed at separate market failures
- Both policies have uncertain costs that must be balanced against expected – but uncertain -- payoffs.

Would Results Change if Threshold Likely?

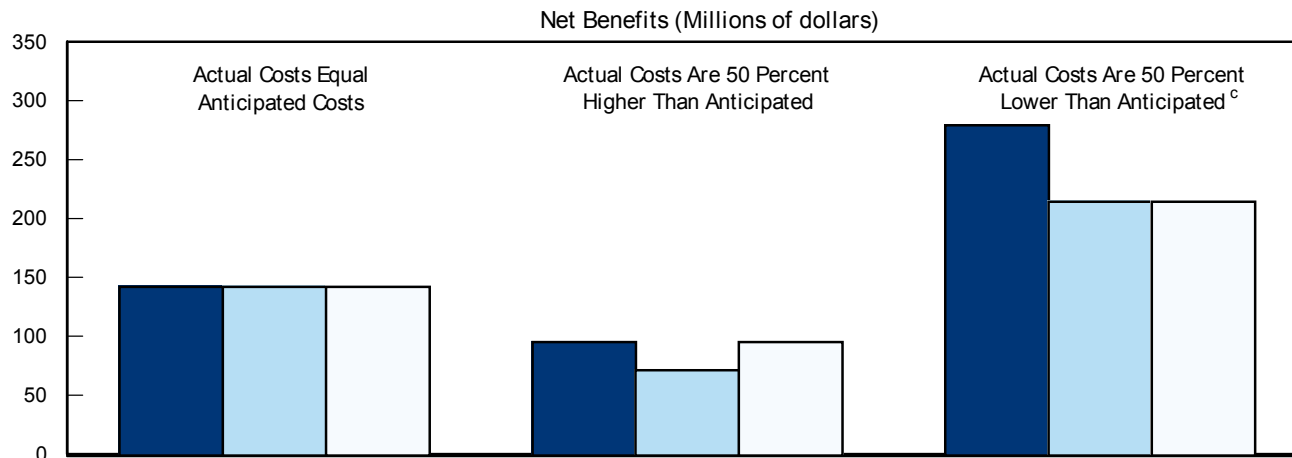
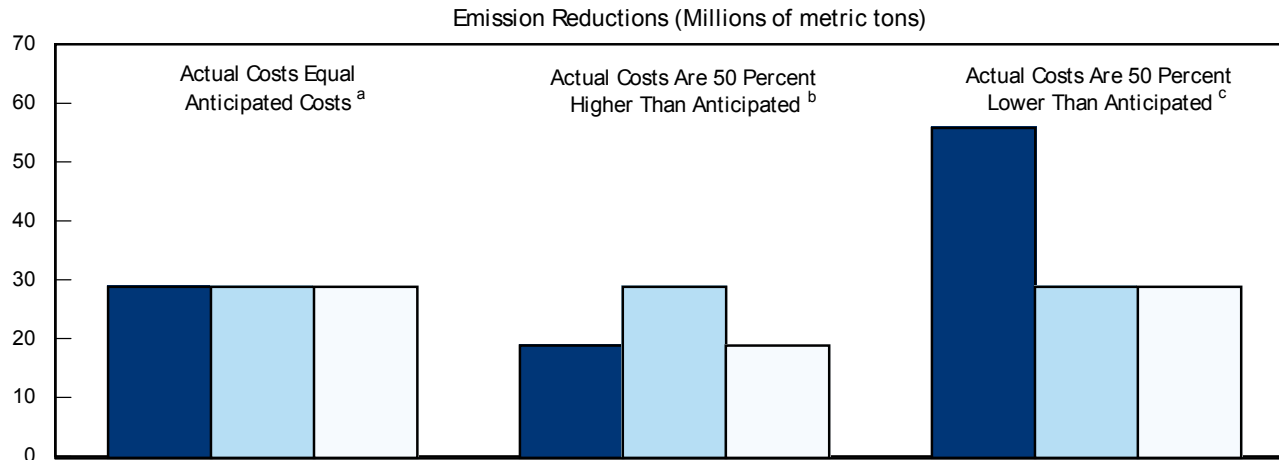
- IF Threshold:
 - Unacceptable damages if concentration exceeds threshold
 - Silver bullet technologies may be necessary to avoid crossing threshold
- Near-term reductions impose costs but don't solve the problem. BUT could still have value:
 - Could delay crossing threshold
 - Could buy time for silver bullet technologies to be developed and deployed
 - Could motivate emission reductions that cost less than the PDV of future technology.

Are All Price Mechanisms Equally Advantageous?

- Tax or cap both price carbon → raise fossil fuel prices
 - Identical outcome under certainty about mitigation costs
 - Under uncertainty: tax more efficient
 - Encourages extra reductions if costs are low
 - Allows the cap to be exceeded if costs are high
- Safety valve is a hybrid approach
 - Less likely to maximize net benefits than tax
 - More likely to max. net benefits than fixed cap

An Illustrative Example of the Relative Advantage of Alternative Policies to Reduce U.S. Carbon Emissions in 2010.

(Arbitrarily assumes a benefit of \$10 per metric ton)



Conclusions

- Enormous uncertainties cast doubt on quantitative estimates of efficient policies.
- Qualitative findings provide consistent evidence that most efficient approach would entail both carbon pricing and R&D support:
 - Delaying near-term pricing likely to increase cost
- Given uncertainties, carbon tax more likely to maximize net benefits than a carbon cap.
 - Safety valve is a hybrid approach, inferior to a tax but superior to a fixed cap
- U.S. reductions alone would be insufficient
 - Growing emissions from rapidly developing countries
 - Environmental benefits diminished if carbon intensive industries move abroad

CBO Reports on Climate Change

All available under “Special Collections” at www.cbo.gov

- Sept. 2006 Evaluating the Role of Prices and R&D in Reducing Carbon Dioxide Emissions
- March 2006 CBO’s Comments on the White Paper “Design Elements of a Mandatory Market-Based Greenhouse Gas Regulatory System”
- March 2005 Limiting Carbon Dioxide Emissions: Prices vs. Caps. (Issue Brief)
- Jan. 2005 Uncertainty in Analyzing Climate Change: Policy Implications
- Nov. 2003 Issues in the Design of a Cap and Trade Program for Carbon Emissions (Issue Brief)
- July 2003 Shifting the Cost Burden of a Carbon Cap-and-Trade Program
- April 2003 The Economics of Climate Change: A Primer
- April 2003 Addressing the Uncertain Prospect of Climate Change (Issue Brief)
- March 2003 The Economic Costs of Reducing Emissions of Greenhouse Gases: A Survey of Economic Models (Technical Paper)
- June 2001 An Evaluation of Cap and Trade Programs for Reducing U.S. Carbon Emissions
- June 2000 Who Gains and Who Pays Under Carbon-Allowance Trading