

Policy Uncertainty in the Market for Coal Electricity: The Case of Air Toxics Standards

Gautam Gowrisankaran
Columbia University, NBER, and CEPR

Ashley Langer
University of Arizona and NBER

Wendan Zhang
Renmin University

July 22, 2022

Economic Consequences of Policy Uncertainty

- Uncertainty over government policy affects important and irreversible decisions such as technology adoption, entry, and exit.
- The process of forming and implementing policies often creates uncertainty.
 - In the U.S., new policies occur through legislation and/or regulations.
- Legislation is infrequent and often empowers agencies to make specific regulations.
 - However, developing regulations takes time, and regulations are subject to court challenges and executive branch changes.
- This system may lead to more responsive policies.
 - But uncertainty can both increase costs and delay policy objectives.

Goals of the Paper

This paper focuses on the cost of uncertainty in environmental policy:

- 1 Estimate beliefs about the likelihood of Mercury and Air Toxics Standard (MATS) enforcement.
 - MATS regulated emissions from electricity generation.
 - Model generators' exit and abatement technology adoption decisions.
- 2 Simulate how policy uncertainty affects counterfactual outcomes in the industry.
 - Evaluate how policy uncertainty affects pollution, exit, and compliance costs.

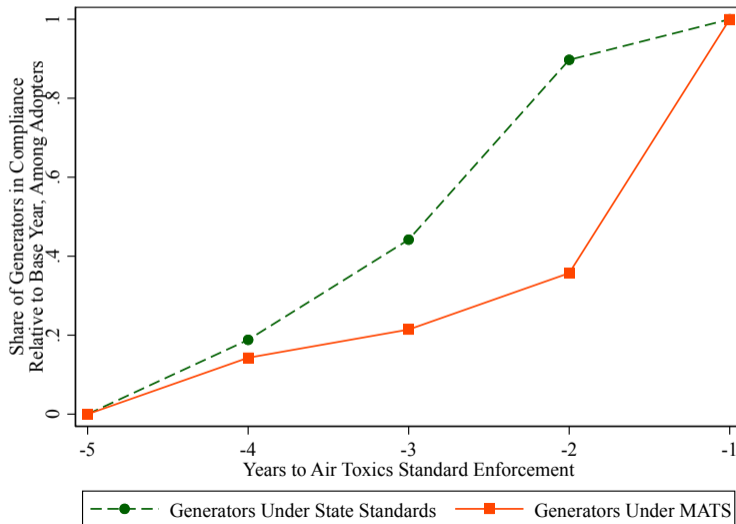
We estimate a dynamic equilibrium model, that models technology adoption and exit:

- Allows us to estimate policy uncertainty from observed behavior.
- Equilibrium counterfactuals then allow us to quantify the impacts of uncertainty.

Mercury and Air Toxics Standard (MATS)

- The EPA released the final MATS rule in 2012 with enforcement in 2016.
 - MATS was challenged up to the Supreme Court, but ultimately enforced.
- While the federal government was formulating air toxics policy, some U.S. states mandated air toxics reductions for generators within their borders.
 - These policies were largely certain once announced.
- Can use these generators to identify extent of policy uncertainty in MATS.

Visual Identification of Perceived Enforcement Probabilities



Overview of Modeling

- Every year, generators subject to MATS:
 - ① Form beliefs about the 2016 enforcement probability.
 - ② Simultaneously decide whether to adopt abatement technology, exit, or continue.
 - ③ Earn operating profits by supplying electricity to hourly markets within the year.
- We estimate a dynamic oligopoly model of coal generator actions from 2006-17.
 - Focus on coal independent power producers (IPPs), who face market incentives.
- We develop new, *simple* estimators of ramping costs to calculate operating profits.
 - Discrete choice of generation, with appropriate controls for dynamic incentives.

Adoption Cost, Exit Value, and Belief Estimation Results

	Base Specification
Predicted Enforcement Probabilities:	
Probability 2012	1.000*** (0.061)
Probability 2013	0.699*** (0.120)
Probability 2014	0.433*** (0.109)
Probability 2015	0.999*** (0.107)
Generator Costs:	
Adoption Cost (million \$)	150.9** (75.1)
Extra MATS Adoption Cost (million \$)	398.7*** (72.1)
Exit Scrap Value (million \$)	-196.4*** (37.4)
$1/\sigma$ (million \$)	63.6*** (5.7)

Note: Structural parameter estimates from nested-fixed point estimation. Parametric bootstrap standard errors in parentheses.

Counterfactual Results

	Prob = 0.7827 All Years	Enforced with Prob = 0.7827
Adoption Costs (Bill. \$)	7.30	6.53
Exit Costs (Bill. \$)	19.24	18.74
Total Profits (Bill. \$)	46.74	48.66
Pollution (Mill. lbs. SO ₂)	867.52	946.50
Number of Generators:		
2012	191.0	191.0
2013	176.5	175.9
2014	163.1	161.9
2015	150.7	148.8
2016	131.0	130.1
Count Adopting	13.7	12.85

- Eliminating uncertainty saves \$930 mil., but increases pollution \$809 – \$2,206 mil.
- It allows generators to operate when gas prices, profits, *and pollution* are highest!

Conclusion

- We estimate the extent and impact of policy uncertainty for MATS.
 - The difference between certain state policies and MATS identifies the perceived probability of enforcement.
 - We develop a new approach to estimating ramping costs, that is easy to implement.
- Main findings:
 - ① Substantial uncertainty surrounding MATS enforcement in 2013 and 2014.
 - ② Eliminating uncertainty increases generator expected profits by \$930 million.
 - ③ It *increases* pollution by allowing generators to better time market uncertainty.