

The Role of Environmental Feedbacks in
General Equilibrium Environmental Policy
Analysis

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This Paper's Question

How are estimates of the general equilibrium cost of a new energy tax affected by relationship between air quality and the economy?

Broader Agenda

To synthesize results on the general equilibrium implications of environmental policies with the theory of non-market valuation.

The environment "feeds back" on the economy.

This Paper's Answer

A PM_{10} -based air quality amenity introduces substantial error in practical measures of the excess burden of a new energy tax.

The sign and magnitude of this error depends on the **interaction** between the leisure-labor choice and the air quality amenity.

Design of the Experiment

GE analysis has focused on the cost of pre-existing labor market distortions (tax-interaction effect).

Goulder & Williams (2003) incorporate these effects in a practical deadweight loss formula and evaluate its performance in a simple numerical model.

We add a non-separable air quality amenity to the final demand system and repeat the G-W energy tax experiment.

The change in the performance of their formula represents the contribution of the environment to the cost of the new tax.

Model Calibration

- Same benchmark data for 1995 US economy
- Same benchmark labor supply elasticities
- Representative range of air quality benefit estimates from hedonic property value models (0.6% – 2% of GDP)
- PM_{10} emissions from U.S. EPA (1995)

Excess Burden by MWTP for Air Quality Improvements
5% Energy Tax, Preference #1

%AQ\$	<i>EV</i>	<i>EB</i>	<i>EB</i> (H)	<i>EB</i> (GW)	% error(H)	% error(GW)
<i>Complements</i>						
0.6%	2.61	3.07	0.54	2.80	-82.51	-8.82
2%	2.31	3.81	0.54	2.81	-85.75	-26.39
<i>Substitutes</i>						
0.6%	2.05	2.52	0.53	2.80	-78.89	10.81
2%	0.84	2.32	0.53	2.80	-77.16	20.22

EV, *EB*, *EB^H*, *EB^{GW}* in billions of 1995 dollars; 40% pre-existing labor tax.

%AQ\$ — Benchmark value of air quality as % of GDP

EV — Equivalent variation (true policy cost)

EB — Appx. **market-based** policy cost

EB(H) — Harberger triangle estimate

EB(GW) — Goulder-Williams estimate

% error(H) — $(EB^H - EB)/EB \cdot 100$

% error(GW) — $(EB^{GW} - EB)/EB \cdot 100$

Broader Implications

Feedbacks between the economy and the environment may pose other conceptual and methodological challenges:

- Measurement of GE costs and benefits
- Exact aggregation revisited (amenity distribution || income distribution)
- Instrument choice
- Non-convexities in production and consumption technologies
- Joint-system instability

Closing

Non-market interactions are quantitatively significant.

Future research should focus on understanding the empirical connections between market and non-market goods.

A broader agenda should seek to describe the interface between the environment and economy and the numerical tools required for policy analysis in this context.