Cost-Containment: A Comparison of Instruments

CEEPR Workshop
The EU ETS: Perspective and Lessons
January 25, 2008

Mort Webster, Lisa Jacobovits, Angelo Gurgel, Denny Ellerman
Massachusetts Institute of Technology
Outline

• Motivation:
  – Lieberman-Warner vs. Bingaman-Specter

• Model Analysis
  – Safety Valve vs. Borrowing
  – Uncertain shock to carbon price

• Discussion
Cost-Containment in the Proposed Bills

- Both have banking provisions
  - Reduce more in initial years - not controversial

- What do we do if it costs *more* than we expect?

- Bingaman-Specter Bill
  - Technology Accelerator Payment (Safety Valve)

- Lieberman-Warner Bill
  - Borrowing (with some limits)
  - Carbon Market Efficiency Board
Research Question

• Allocate emissions permits for 2015-2050

• What if the costs in the first period (2015) are more than expected?

• Is it better to have a:
  – Safety Valve
  – Borrowing
  – [Intensity Target]
Numerical Model Analysis

• Do not focus on the numbers

• Focus on the intuition!
Summary (Preview)

• Want some form of cost-containment

• Safety Valve: Costs less, abates less

• Safety Valve can simulate borrowing
  – Important to get the trigger price right
Study Design

- Forward-looking MIT EPPA model
- Hypothetical emissions reductions
- Temporary shock to carbon price in 2015
- Compare four alternatives
  - No Cost-Containment
  - Borrowing
  - Safety Valve
  - Safety Valve with cumulative cap enforced
Compensated Safety Valve

- Chief Objection to Safety Valve:
  - Cumulative cap not enforced
  - If cumulative emissions matter, this is a problem
- Possible Solution:
  - Have a Safety Valve with preset trigger price
  - If original cap exceeded, use automatic formula to distribute reductions in future permits
Impact of Banking

• Typical proposed emissions caps
  – Start gradual, decrease sharply later
  – Would induce net banking

• If you expect net banking
  – No need for Borrowing or Safety Valve

• This Analysis:
  – Hypothetical path of emissions caps
  – No net banking
Hypothetical Policy

CO₂ Emissions (mmt C)

Hypothetical Emissions Reductions
No Emissions Reductions
“Borrowing” defined

In this analysis, Borrowing:

• Is unrestricted (any year 2015-2050)
• Has no penalty or interest
• Performed with perfect foresight
Safety Valve vs. Borrowing Under Uncertainty

- Monte Carlo Simulation
  - Uncertain shock to carbon price in 2015
  - 1000 random samples

- Safety Valve
  - Trigger price is constant across all shocks
  - Initial Guess:
    - Expected (non-shock) Carbon Price
Uncertainty in Carbon Price in 2015

![Graph showing the uncertainty in carbon price in 2015. The x-axis represents the carbon price per ton of CO₂, ranging from $30 to $90, and the y-axis represents probability density from 0.00 to 0.04. The graph is blank, indicating no data points.](image-url)
Uncertainty in Carbon Price in 2015

Only Consider Higher Cost Outcomes
Quick Tutorial on CDFs

CDFs (Cumulative Distribution Functions) show the cumulative probability of a random variable. The probability density function (PDF) is the derivative of the CDF, indicating the density of the probability at different values. The total area under the PDF curve is equal to 1.

The graph above illustrates a CDF with a probability density function. The CDF increases as the carbon price increases, indicating a higher cumulative probability of observing higher carbon prices.
CO₂ Emissions with Sample Price Shock

2015

No Cost-Cont.Borrowing
SV
Comp SV

Higher Emissions To Absorb Shock

2020

Must make up Emissions later
Uncertainty in 2015 CO₂ Emissions (Year of Price Shock)

- Emissions Cannot adjust To shock
- Emissions adjust optimally to each shock
- Emissions Over-adjust To shock (fixed trigger price)

Cumulative Probability

CO₂ Emissions in 2015

No Cost-Containment
Borrowing
Safety Valve
Compensated Safety Valve
Uncertainty in Policy Costs
(Cumulative over 2015-2050)

No Cost-Containment always has highest costs
Borrowing slightly better than Comp SV
Safety Valve always has lowest costs
Effect of Different Trigger Prices under Uncertainty

- “REF” trigger price
  - Expected (no-shock) carbon price
- Alternative trigger prices (relative to ref):
  +15%,
  +30%,
  -30%,
  -70%
Carbon Prices with Different Trigger Prices
Mean Welfare Impacts
Compensated Safety Valve

“Too Low”
a trigger price
is the most costly
Summary (I)

• Want some form of cost-containment

• Safety Valve: Costs less, abates less

• Compensated Safety Valve
  – Can simulate borrowing
  – Important to get the trigger price right
  – Too low is worse than too high
Summary (II)

• Caveats:
  – “Borrowing” perfectly efficient, perfect foresight
  – Different for “permanent shocks” (e.g., GDP)?

• Best mechanism for cost-containment?
  – Gov’t appointed board?
  – Individual firms moving permits over time?
  – Automatic mechanism (compensated SV)?