Laboratory Experiments Inform Emissions Permit Market Design

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Markets are Influenced by Universal Natural Forces

• **Why** conduct experiments? They provide a step towards understanding whether predictions developed through theoretical reasoning can be applied to more complex field conditions

• Laboratory markets are populated by profit-motivated human agents, just as markets are in the field

• **Wind tunnel** testbedding
  – Imagine testing a new wing design on an airplane without first assessing its actual aerodynamic properties in controlled wind tunnel testing
  – Note that such testing focuses on *specific* components of a new aircraft, not the entire system
Example #1: Banking and Price Volatility

Prices are relatively stable over time when traders can use banking to store unused permits or carry forward permits as a buffer against emissions shocks.

Figure 2: Transaction Prices for Session BUN3, with Banking and Uncorrelated Emissions Shocks
Especially if emissions shocks are correlated (e.g., due to weather), *price spikes and crashes* occur without banking at the end of some compliance periods.

![Figure 3: Transaction Prices for Session NBCO3, with No Banking and Correlated Emissions Shocks](image)

Examples of price spikes following positive emissions shocks

Examples of price crashes following negative emissions shocks

Other designs, such as overlapping permit validity periods, can also reduce price volatility.

Source: Cason & Gangadharan (2006, *JEBO*)
Example #2: Buyer Liability Rules Create Incentives for Sellers to Invest in Reliability

Prices for Session BI20406x with Reliability Investments and Inspections (twice experienced)

Source: Cason (2003, *EARE*)

Buyer liability may perform poorly, however, when sellers cannot inspect reliability investments (Godby & Shogren, 2008)
Example #3: Auction Rules can Strongly Influence Revenue Raised and Price Discovery

• Earliest government permit auctions (U.S. SO$_2$ permits, starting in 1993) resulted in biased price signals for this emerging market

• **Uniform price** auctions (such as an ascending price clock auction) reduce incentives to strategically manipulate bids to influence price

• Substantial revenue recycling benefits from auctioning rather than freely allocating permits
  – Provides resources to more directly assist harmed industries and consumers (regressive impacts of increased energy costs)
  – Estimates for U.S. suggest that a policy applied upstream needs only 5 to 15 percent freely allocated to preserve energy industry asset values (Bovenberg & Goulder, 2001)
Example #4: Compliance and Enforcement

- Compliance responds to enforcement efforts, and it interacts with other design features
  - E.g., noncompliance may increase with more flexible banking and trading rules (C&G, 2006 *JEBO*)
  - Permit market equalizes compliance costs across firms, but experiments reveal that net permit buyers tend to have lower average compliance (Murphy & Stranlund, 2006 *JEBO*)
  - Increased enforcement has both a direct positive effect on compliance incentives, but also an indirect negative effect by forcing permit prices higher (M&S)
Conclusion: The Devil is in the Details

• Researchers have come a long way from the 1970’s naïve proposals to “plant a market, let it grow”

• Distributional, economy-wide implications are best assessed using CGE modeling techniques

• **Economics experiments** are useful for evaluating some details regarding market design, permit characteristics, liability rules, auction rules, enforcement, etc.