US EPA ARCHIVE DOCUMENT

Mercury: the good, the bad, and the export ban

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Bottom-line Contribution

- Numeric model of US and World Mercury Markets
- Welfare analysis of Export Ban
- Alternative Policy: Direct Purchase and Retire
- Export Ban is inferior (or equivalent) if
  - Social benefits of domestic sequestration greater than about 1¢/100tonnes/household/year
  - (equivalent only if there is no price response)

Overview

- Background
- Analytical Model
- Computational Model
- Policy Simulation Results
- Conclusion

Mercury: the good, and the bad

- Mercury is a useful resource
  - Science
  - Industry
- Mercury is a toxic heavy metal
  - Bioaccumulates
  - Global *transboundary* pollutant
  - Special RCRA Laws

Commodity Mercury in the US

- Mercury demand is on a steady decline in the US
  - High environmental valuations
  - Inexpensive knowledge capital
  - Substitute technologies
- Mercury supply is high
  - Byproduct Mercury: 50%
  - Chlor-alkali industry: 25% (annualized)
  - Recycled and recovered: 25%
- At current prices we are looking at about 200 tonnes of output and about 100 tonnes of consumption
- Exports

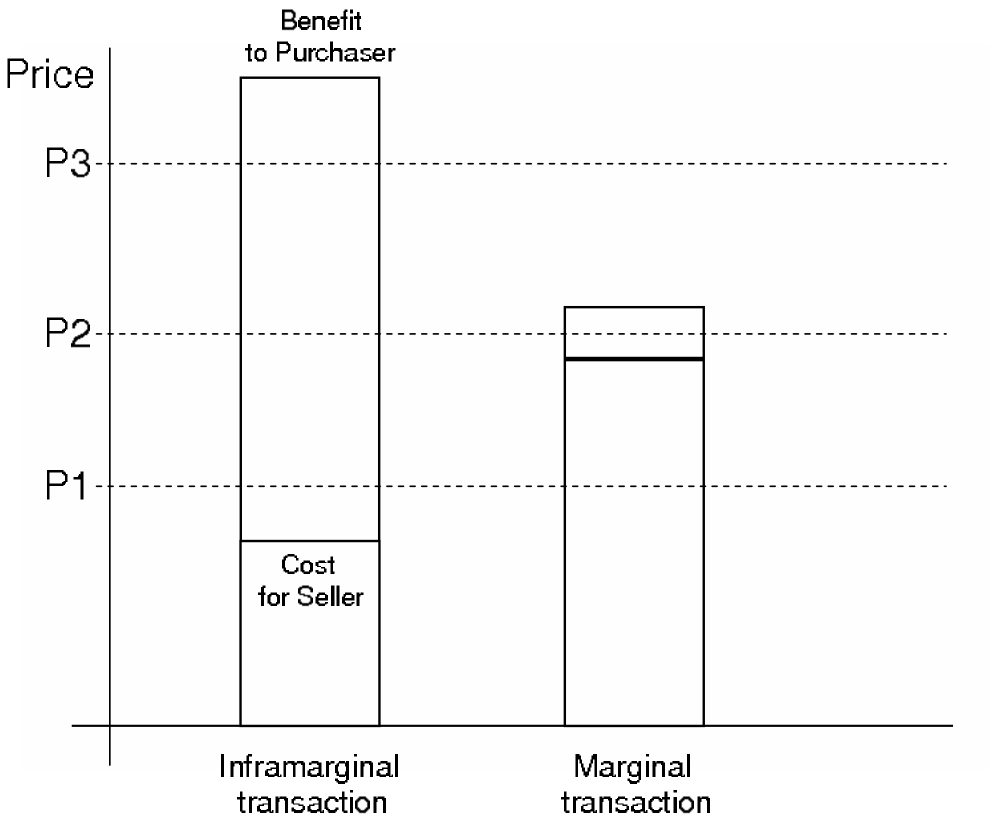
Major Players

- Foreign Artisanal Miners
- The Public
  - Multilateral Policies
  - Unilateral Policies
- Other Market Players
  - Kyrgystan, China, Artisanal Hg Miners
  - Gold Mining
  - Chlor-alkali, and PVC in China
  - Dental, Batteries, Switches, Instruments, etc.

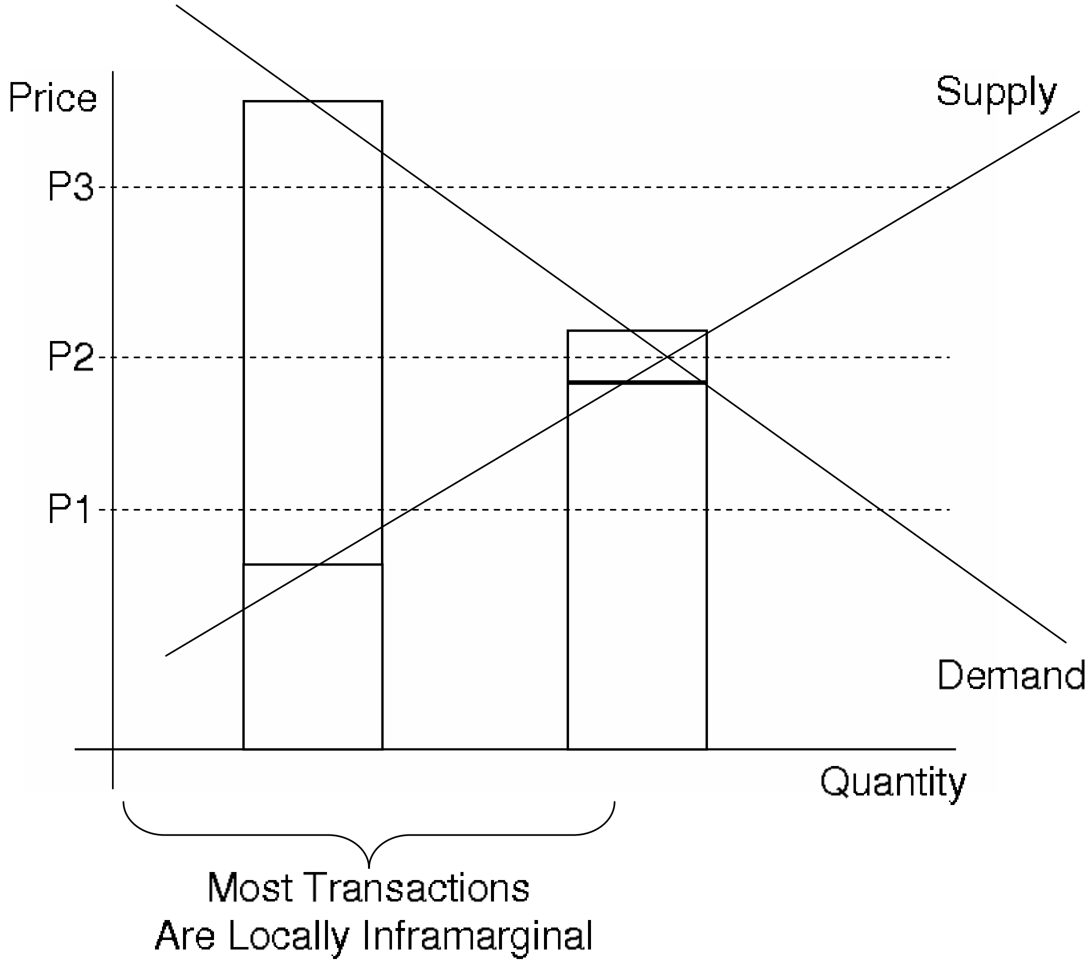
Ground Rules

- Equity versus Efficiency
- Weak Law of Demand
- Weak Law of Supply
- *...all else equal*
- Normalized Mercury Transaction

Marginal vs. Inframarginal Trades



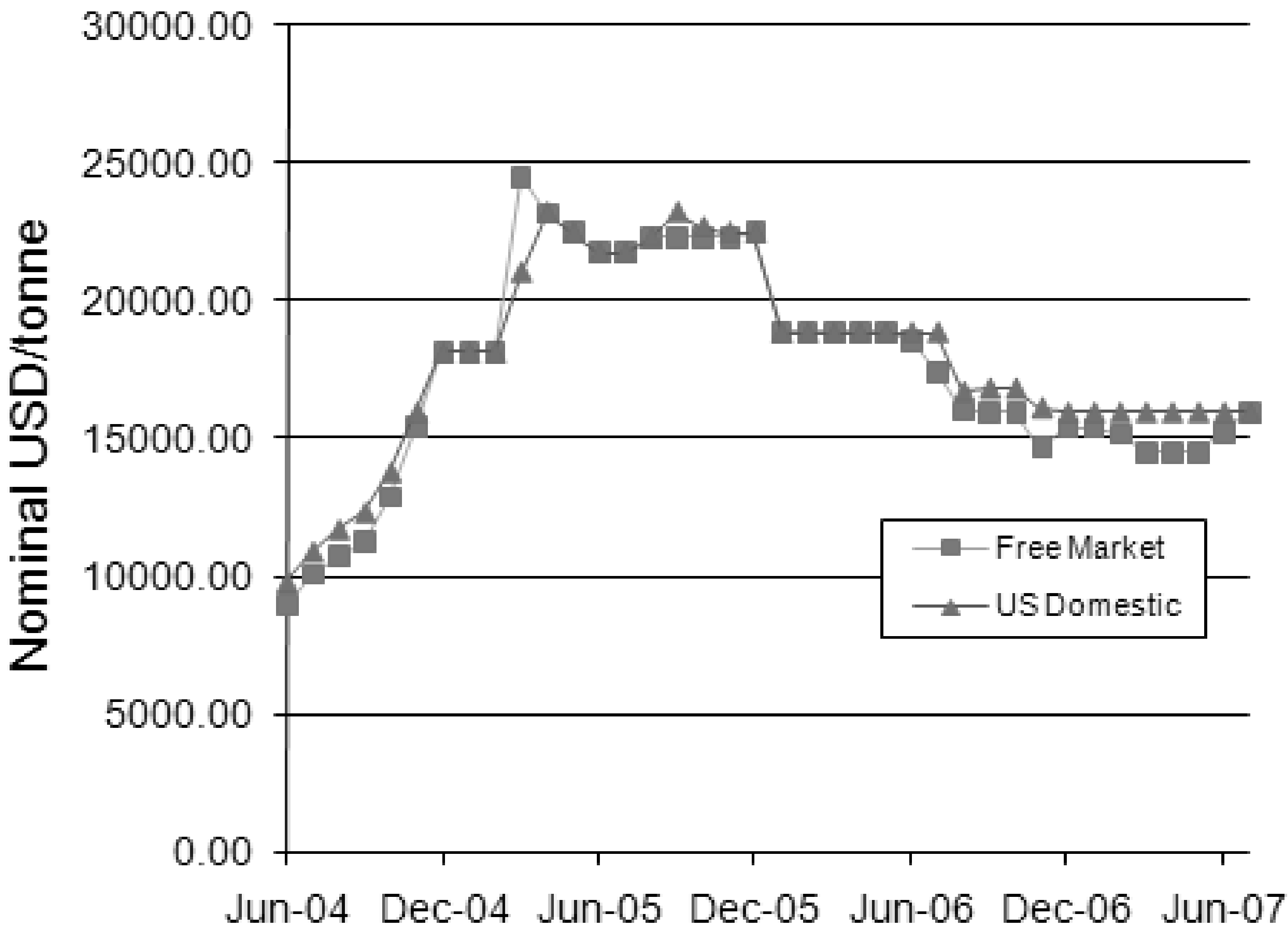
Marginal vs. Inframarginal Trades



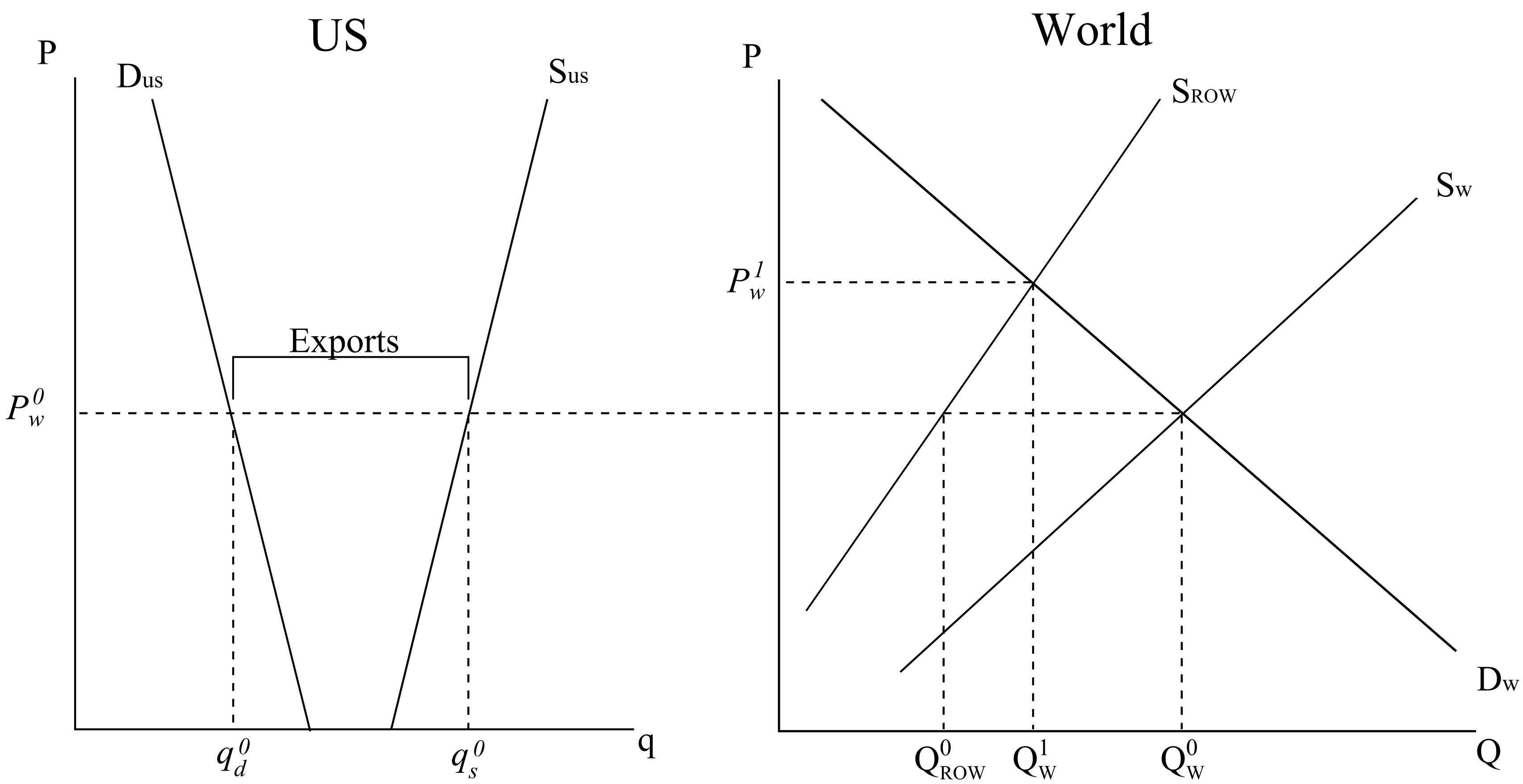
Ground Rules (cont.)

- Do mercury market participants respond to price?
- Is a market (economic) model appropriate?
- Higher or lower value shares do not indicate price response.
- Anecdotes about inframarginal transactions do not indicate a lack of price response.
- The price series for mercury looks just like any other market: shocks happen, prices react, and the market clears.

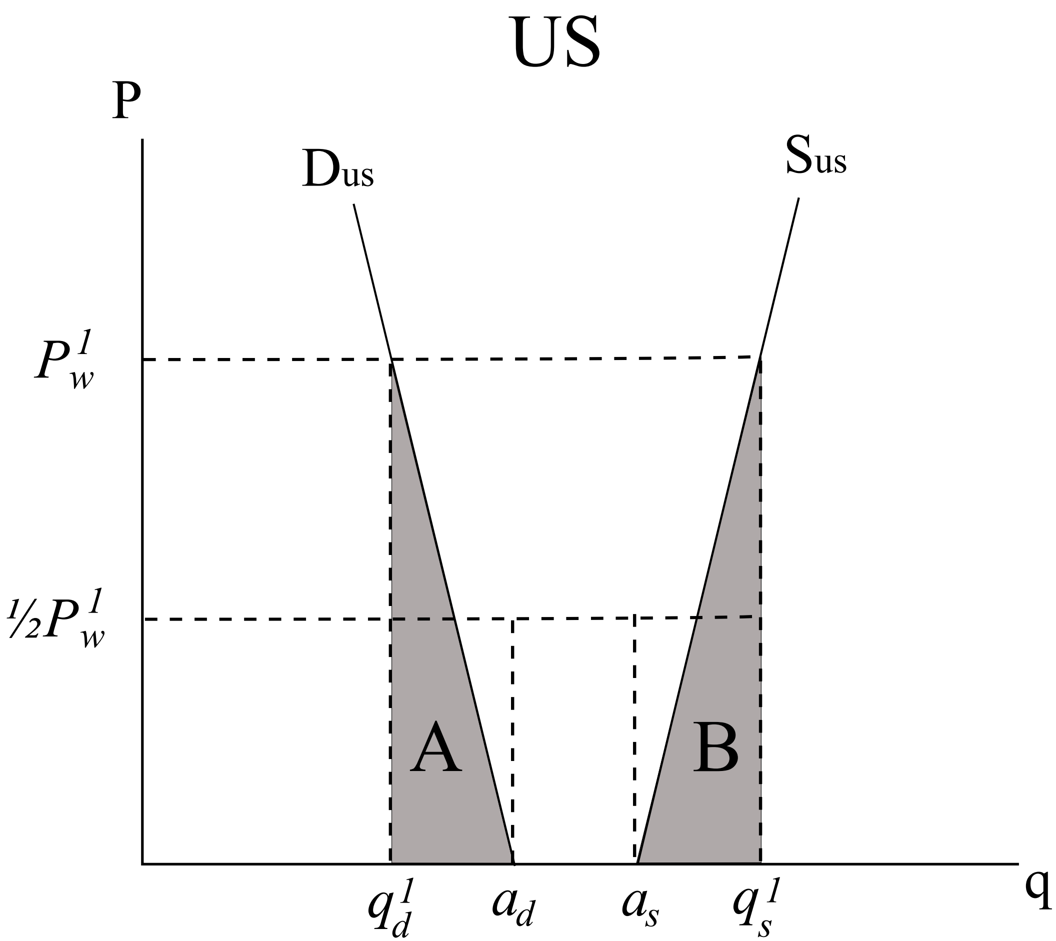
Recent Prices (compiled from Platts)



US and World Mercury Markets



US Market



Model

$$q_d = a_d + b_d P_{us}$$

$$q_s = a_s + b_s P_{us}$$

$$r_d = c_d + d_d P_w$$

$$r_s = c_s + d_s P_,$$

Model cont.

US Market Clearance:

$$q_s - q_d - E - G \geq 0 \quad \perp \quad P_{us} \geq 0$$

World Market Clearance:

$$r_s + E - r_d \geq 0 \quad \perp \quad P_w \geq 0$$

Export Activity:

$$P_{us} - P_w \geq 0 \quad \perp \quad E \geq 0$$

Surplus tracking:

$$S - q_s + q_d + E + G \geq 0 \quad \perp \quad S \geq 0.$$

Purchase until the target is hit:

$$P_{us} - P_w^1 \geq 0 \quad \perp \quad G \geq 0.$$

Benchmark Reference Quantities

		tonnes (t) of mercury
US		
Demand	(q_d^0)	100
Supply	(q_s^0)	200
Exports	$(q_s^0 - q_d^0)$	100
World		
Demand	(Q_d^0)	3000
Supply	(Q_s^0)	3000

Benchmark Unit-value Assumptions

	$/$t$	**¢/100t per US household**
Market Price ($P^0_{us} = P^0_w$)	$16,000	1.6¢
Annual Marginal Benefit of Domestic Sequestration (MB_{US})	$10,000	1.0¢
Annual Marginal Cost of Sequestration	$1,000	0.1¢

Central Values of Key Response Parameters

		Local Elasticity	Implied Intercept
US			
Demand	(η_{US})	0.1	$110t$
Supply	(γ_{US})	0.1	$180t$
Rest of World			
Demand	(η_{ROW})	0.5	$4500t$
Supply	(γ_{ROW})	0.2	$2320t$

US Welfare Analysis (central case)

Account	**Export Ban ($thousands)**	**Direct Purchase ($thousands)**
Consumer Surplus	1,680	-77
Producer Surplus	-3,040	154
Government	0	-1,701
Sequestration	-70	-101
US Environment	-300	14
No Exports	$+X$	$+X$
Total	$+X - 1{,}730$	$+X - 1{,}711$

Mercury Leakage Rates (%) at zero US exports

	Supply Elasticity (γ_{ROW})			
	0	**0.2**	**1.0**	**100**
Demand Elasticity (η_{ROW})				
0.1	0	66	91	100
0.5	0	28	66	100
1.0	0	16	49	99

Export Ban ($thousands) relative to the Direct Purchase

Elasticities (η_{US}, γ_{US})	Marginal Social Benefit of Sequestration (MB_{US}) $5,000/$t$	$10,000/$t$	$20,000/$t$	$30,000/$t$
(0.0, 0.0)	0	0	0	0
(0.1, 0.0)	-46	6	111	216
(0.0, 0.1)	-92	13	223	432
(0.1, 0.1)	-138	19	334	648
(0.2, 0.1)	-183	26	445	864
(0.1, 0.2)	-230	32	556	1,080
(0.2, 0.2)	-276	39	668	1,296

Conclusion

- Quantitative framework is useful
- Elasticity estimation
- Environmental valuations
- Mercury problem is highly tractable
  - Sequestration cost is low
  - Eliminating exports is relatively cheap
- Export ban cannot generate incentives to
  - Curtail domestic mercury use
  - Intensify mercury recovery
- ...and will likely do the opposite