Presentation: The Effects of Nonbinding Price Floors

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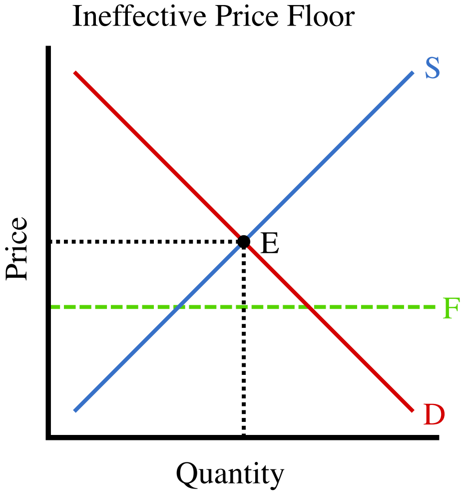
Economic Principles Summarized in Wikipedia



Heretical Thoughts: Price Floors Below the Equilibrium Price Can Cause the Price to be Higher

- In laboratory experiments, Holt and Shobe (2016) showed that, even when the *soft floor* was strictly below the spot price, raising this auction reserve price raised the observed spot price of "emissions permits."
- In a similar vein, the *Financial Times* (August 19, 2013) attributed the high price of Chinese rice to the government's *hard floor*: " Beijing's minimum procurement price for domestic long grain rice is set at $420 per tonne, but spot prices are at about $600 per tonne."
- Holbrook Working (1953) observed that despite the imposition of a *hard floor* for wheat at 90% of the long-run equilibrium price "The program will give growers sound reason to expect prices in its earlier years to average above the equilibrium level"

The Three Literatures: 1. Emission Markets

- Banking and borrowing
  - Banking and borrowing improve emission market performance. Cronshaw and Kruse (1996), Rubin (1996), Rubin and Kling (1993), Schennach (2000)
- Price collars (sometimes refered to as "hybrid instruments"), Pizer (2002), Burtraw et al. (2010), Fell et al. (2012)
  - Relax unresponsive supply of allowances
  - Dampen (truncate) price response
  - Compare to the EU-ETS market stability reserve, an attempt to control price without changing long-run supply

The Three Literatures: 2. Commodity Storage

- When to hold ‘em and when to fold ‘em
- Carry over only if the expected price covers interest and cost of storage, Samuelson (1970), Williams and Wright (1991)
- Hotelling Rule restated: when the cost of storage is zero, the (net) price of a stored commodity must rise at the rate of interest
- Allowances are actually a lot like pork-bellies! Schennach (2000) explicitly acknowledges the parallel. (Not to pork bellies...)

The Three Literatures: 3. Price Controls

- Where there is no uncertainty, a price ceiling need not be binding today to affect today's price. If it is ever binding, it will affect today's price. Dwight Lee (1973)
  - Future actions affect current prices
- This extends to the uncertainty case, but now we need to explicitly model expectations about the future. Williams and Wright (1991)
- Direct controls on price are difficult to pull off and are vulnerable to the very incentives they create. For example, Salant (1983) models "speculative attack" on price control schemes.

Relation to "Target Zone" Models in International Finance

Krugman (1991) considered the behavior of the exchange rate trapped between a hard ceiling and a hard floor.

- Krugman's asset is instead valued for its "convenience yield."
- Krugman derives conditions under which the announced target zone will induce traders to stay inside the zone.

Our Contribution

- We show that a hard or soft floor below the current price in a stochastic carryover model may cause the price to jump up—weakly higher with a hard floor than with a soft floor.

The Common Model with No Floor

- Storable Asset
  1. grain (corn, wheat, rice)
  2. emissions permits
- Market Clearing to Determine the Current Price

$$D(p_t) + \alpha_i + x_t = s_t + g$$

where

1. s_t : the inherited stock
2. x_t : storage
3. α_i : realized shock
4. $D(\cdot)$: grain demand or surrender of permits
5. g : grain harvest or permit auction

How Much to Carry Over

Either (1) speculators just break even ($p_t = \beta E_t(p_{t+1})$), or (2) they expect to lose money from storage, in which case, they carry nothing into the next period ($x_t = s_{t+1} = 0$):

$$x_t \geq 0, p_t - \beta E_t p_{t+1} \geq 0, \text{ and } x_t[p_t - \beta E_t p_{t+1}] = 0.$$

Recursion: Beginning at T with a continuous, bounded expected price function, work backward using the market clearing equation on the previous slide to generate a sequence of carryover functions and price functions:

1. $\{x_t(s_t, \alpha_i)\}_{i=1}^T$
2. $\{p_t(s_t, \alpha_i)\}_{i=1}^T$

In the infinite-horizon, discounted case these sequences converge uniformly to unique limit functions.

Hard and Soft Floors

- Buyback at floor f ("Hard Floor")
- Auction reserve price at floor f ("Soft Floor")

Price can never fall below a hard floor but can fall below a soft floor

Unifying Framework

No floor, a soft floor and a hard floor are special cases of buybacks at f limited not to exceed $\bar{g}$

$$R(p_t;\bar{g}) \begin{cases} = 0 & \text{if } p_t > f \\ \in [0,\bar{g}] & \text{if } p_t = f \\ = \bar{g} & \text{if } p_t < f \end{cases} \tag{1}$$

- No floor: $\bar{g} = 0$
- Soft floor: $\bar{g} = g$
- Hard floor: $\bar{g} = \infty$

Adapting the Common Model for Floors

- Market Clearing to Determine the Current Price

$$D(p_t) + \alpha_i + x_t = s_t + g - \mathbf{R}(\mathbf{p_t}; \bar{\mathbf{g}})$$

  where

  1. s_t : the inherited stock
  2. x_t : storage
  3. α_i : realized shock
  4. $D(\cdot)$: grain demand or surrender of permits
  5. g : grain harvest or permit auction
  6. $\mathbf{R}(\mathbf{p_t}; \bar{\mathbf{g}})$ is the government's constrained buyback function

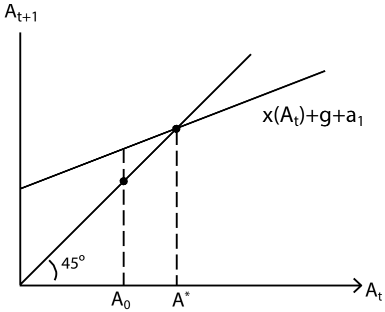
- Following Salant (1983), the same procedure can be followed as in the "no floor" case to derive new price and carryover functions

In Infinite Horizon Model, Necessary and Sufficient for "Nonbinding" Price Floors to Raise the Current Price

Let α_1 be largest possible supply shock. Define A^* as the availability just large enough that $p^N(A^*) = f$.

If a repetition of this shock will eventually drive $A_t > A^*$, then the initial price will jump up when f is imposed as a soft or hard floor.

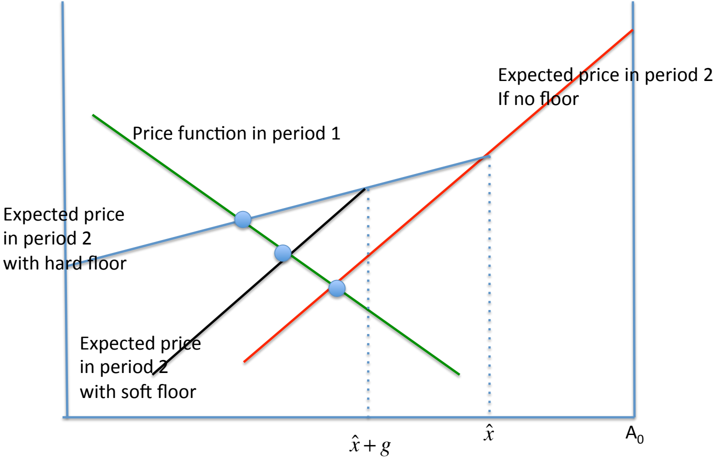
Equivalently, nonbinding floor will cause upward jump up iff $g + \alpha_1 - D(f) > 0$.



Stochastic Generalization of Dwight Lee's Insight

- In Lee's Hotelling model, the price path that was an equilibrium before imposition of his hard ceiling would generate the same extraction path. But at prices above the ceiling the market would no longer clear. There would be no demand for private extraction and hence *excess supply*.
- In our case, the price rule $p^N(A)$ that generated an equilibrium before imposition of the floor would not clear the market if, with positive probability, the available stock ever evolves to more than A^*. For in that case, there would not be just the private demand which would clear the market but the addition of government demand. So there would be *excess demand*.
- The same reasoning could be applied if the government imposed a ceiling as well.

In Two-Period Model, Differential Effects of Hard and Soft Floors



Simulations Results

We simulate a stochastic rational expectations equilibrium:

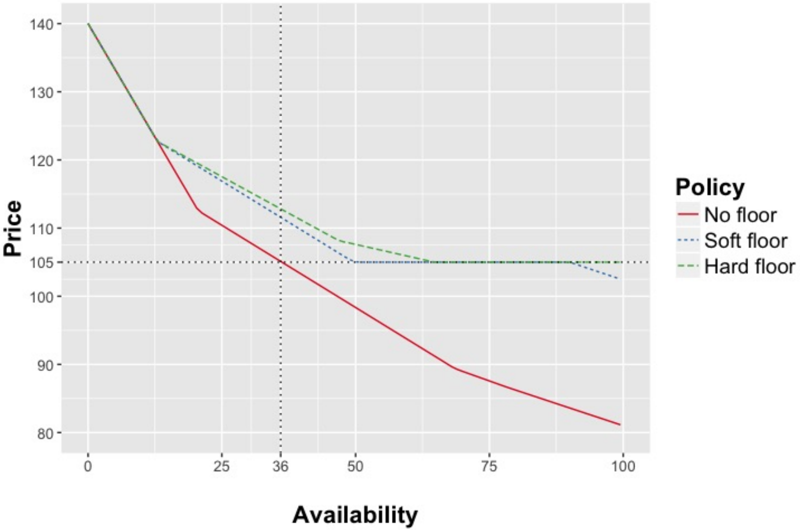
- State at t: $A_t = x_{t-1} + g$
- With arbitrage conditions:
  - $P_t - \beta E_t P_{t+1} \perp 0 \leq x_t \leq Inf$
  - $A = D(P_t) + \alpha_i + x_t + D_g \perp -Inf <= P_t <= Inf$
  - $P_t - P_{floor} \perp 0 \leq D_g \leq \bar{g}$

We first solve for the rational expectations equilibrium functions for x_t, P_t and D_g.

Then we simulate the model using 1,000 draws on the random variable α_i.

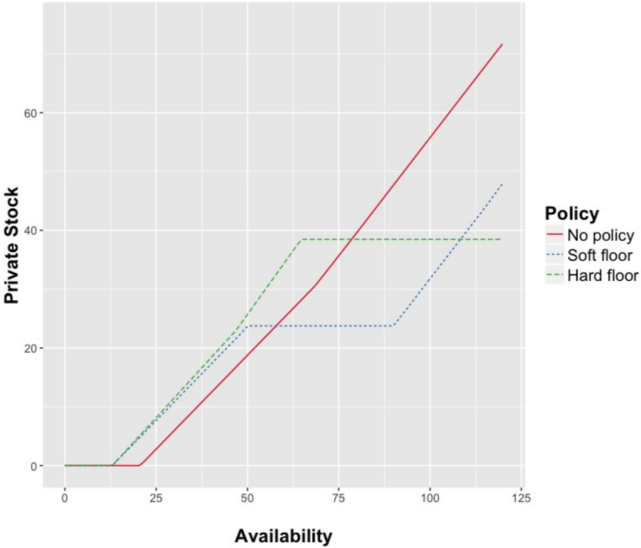
Equilibrium Response of Price to the State Variable

Price floor = \$105



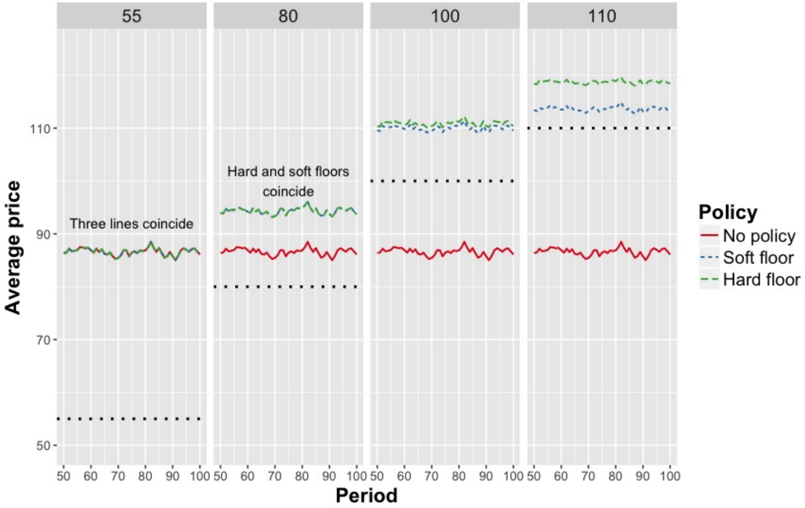
Equilibrium Response of Carry-forward to Availability

Price floor = \$105



Average Prices (periods 50 - 100)

$$P_{floor} = \$55, \$80, \$100, \$110$$



Experimental Test of the Model

- Our theory makes strong predictions about the market response to hard and soft price floors.
- We use a set of laboratory experiments to test the model predictions in the two-period case.
- Given the parameters of our two-period model:

H_1: At $P_{floor} = 70$, no effect on equilibrium price or carryforward
H_2: At $P_{floor} = 100$, $P_N < P_S = P_H$
H_3: At $P_{floor} = 130$, $P_N < P_S < P_H$

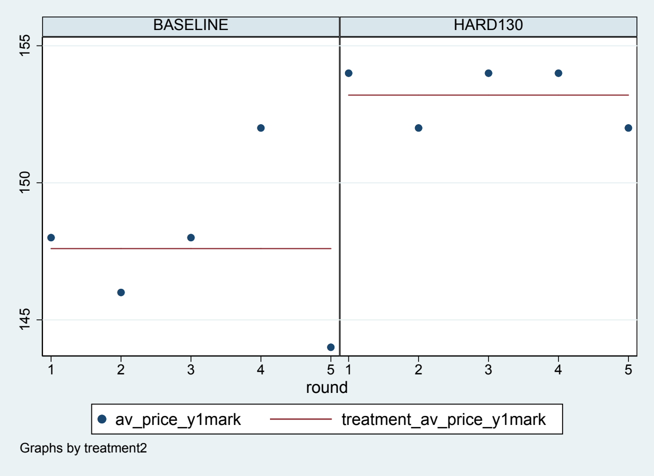
- We use a 3 X 3 design, with 3 policies and 3 price floors.

Lab Setup

- Ten participants, University of Maryland students
- Each session comprises 10 trials: 5 baseline and 5 treatment
- Each trial is a 'two-year' trading regime:
  1. In Year 1, Participants receive 'grain' and cash endowments
  2. They make offers to sell to buyers (known WTP schedule) and how much to save to Year 2
  3. Observe Year 2 consumer WTP: high or low
  4. Bid in uniform price, sealed-bid auction for additional units
  5. Observe auction price
  6. Offer to sell stock of 'grain' to consumers whose WTP schedule is known
- Unfortunately, due to a failure of our experimental apparatus (i.e. summer break) we were only able to complete one session for 2 of our nine cells.

Market Price in Year 1

Treatments: No floor (Baseline) and Hard $130 floor



Carryover from Year 1 to Year 2

Treatments: No floor (Baseline) and Hard $130 floor