Secret Reserve Prices by Uninformed Sellers

Pasha Andreyanov, El Hadi Caoui

February 6, 2020

Intro

Intro

Consider a sealed bid first price auction

- Classic reserve price : commit to a public reserve price.
- Random reserve price : throw dice - set public reserve price.
- Secret reserve price : throw dice - set secret reserve price.
- Secret+adaptive reserve price : watch the bids arrive, maybe throw a dice - chose whether to sell or not.

In practice, reserve prices are often kept secret and we only observe the final decision (to sell or not to sell).

Intro

In the auction theory, there is almost no discussion of secret reserve prices, mostly because people do not understand what's going on, or they think of commitment problems.

"In many situations, especially in art auctions, it is announced that there is a reserve price, but the level of the reserve price is not disclosed. In effect, the seller can opt to not sell the object after learning all the bids and thus the price. But this is rational only if the seller anticipates that in a future sale the price will be higher".
— V. Krishna, "Auction Theory"

In the real world, secret reserve prices are quite popular.

- russian procurement auctions
- french timber auctions

Intro

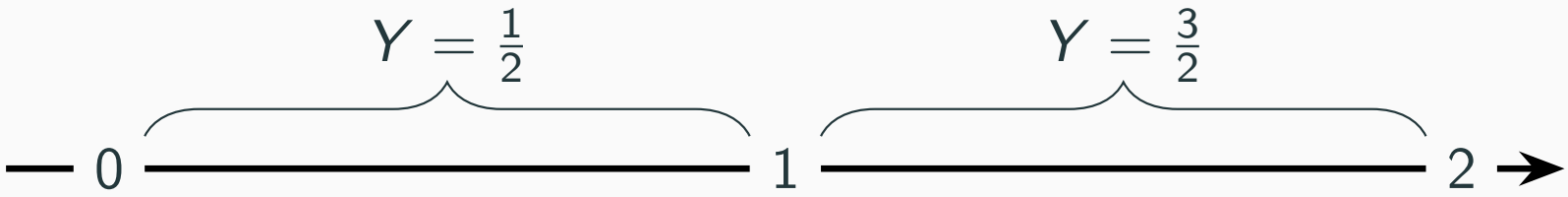
Why would someone use a secret reserve price?

- prevent collusion
- leverage risk aversion
- increase participation
- extract information from the bids

Motivating example

Motivating example

- common value $Y \in \{1/2, 3/2\}$ with equal probability
- private value $V \sim U[-1/2, 1/2]$
- bidder value $Y + V$, auctioneer value Y
- auctioneer does not observe Y
- auctioneer maximize welfare



Auctioneer can perfectly screen Y from the bids and set the reserve price optimally (equal to Y), but he can not set it beforehand.

Case study: Timber sales in France

Case study: Timber sales in France

40 % of all French Timber is sold by ONF (Office National des Forets) using sealed bid first price auctions.

"Contrary to North American timber auctions, the reserve price is not announced in French public timber auctions. We believe that the seller prefers not to commit to any reserve price mainly because she does not know precisely her reservation value at the auction time." — Preguet Waelbroek (2011)

Case study: Timber sales in France

Case study: Timber sales in France

ONF has no utility from the standing timber, their only reservetion value is opportunity cost of future sales.

"Potential buyers usually visit the lots they intend to buy, so as to infer their own private value. From a buyer's point of view, the estimated value of a lot is different from the seller's point of view. Buyers have information on harvesting costs, on what they will produce with the wood and at what price they will be able to sell their products." — Preguet Waelbroek (2011)

So, ONF's utility depends on the private information of the buyers.

Case study: Timber sales in France

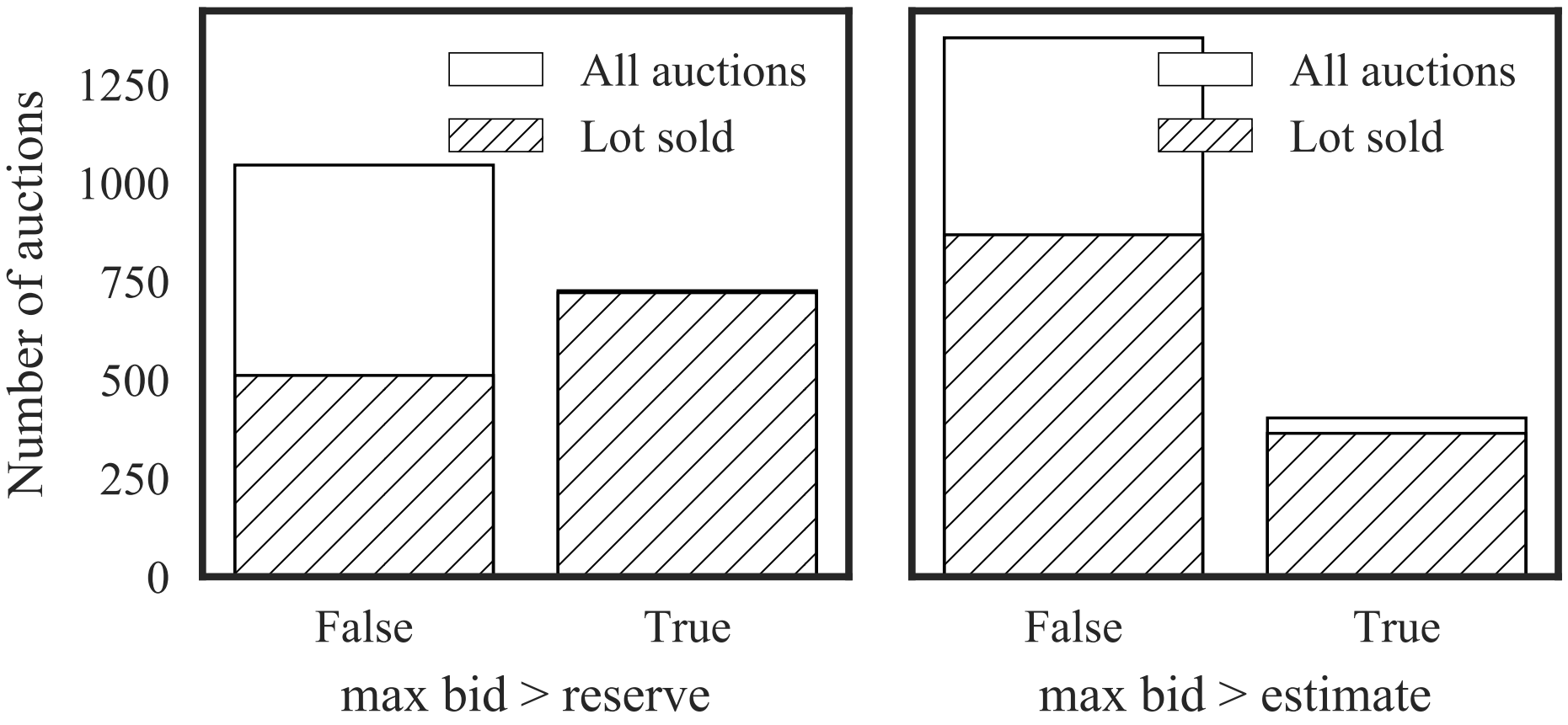
Case study: Timber sales in France

- ten sales of standing timber by the ONF, Fall 2003
- data collected by Costa and and Preget (2004)
- 2262 tracts auctioned via first-price sealed auctions
- bids and bidder identities, tract level characteristics reported inthe sale booklets (estimates of volume per species, surface, number of trees etc.), the ONF'sinitial appraisal value for each tract, and the ONF's ex-ante secret reserve price

Variables

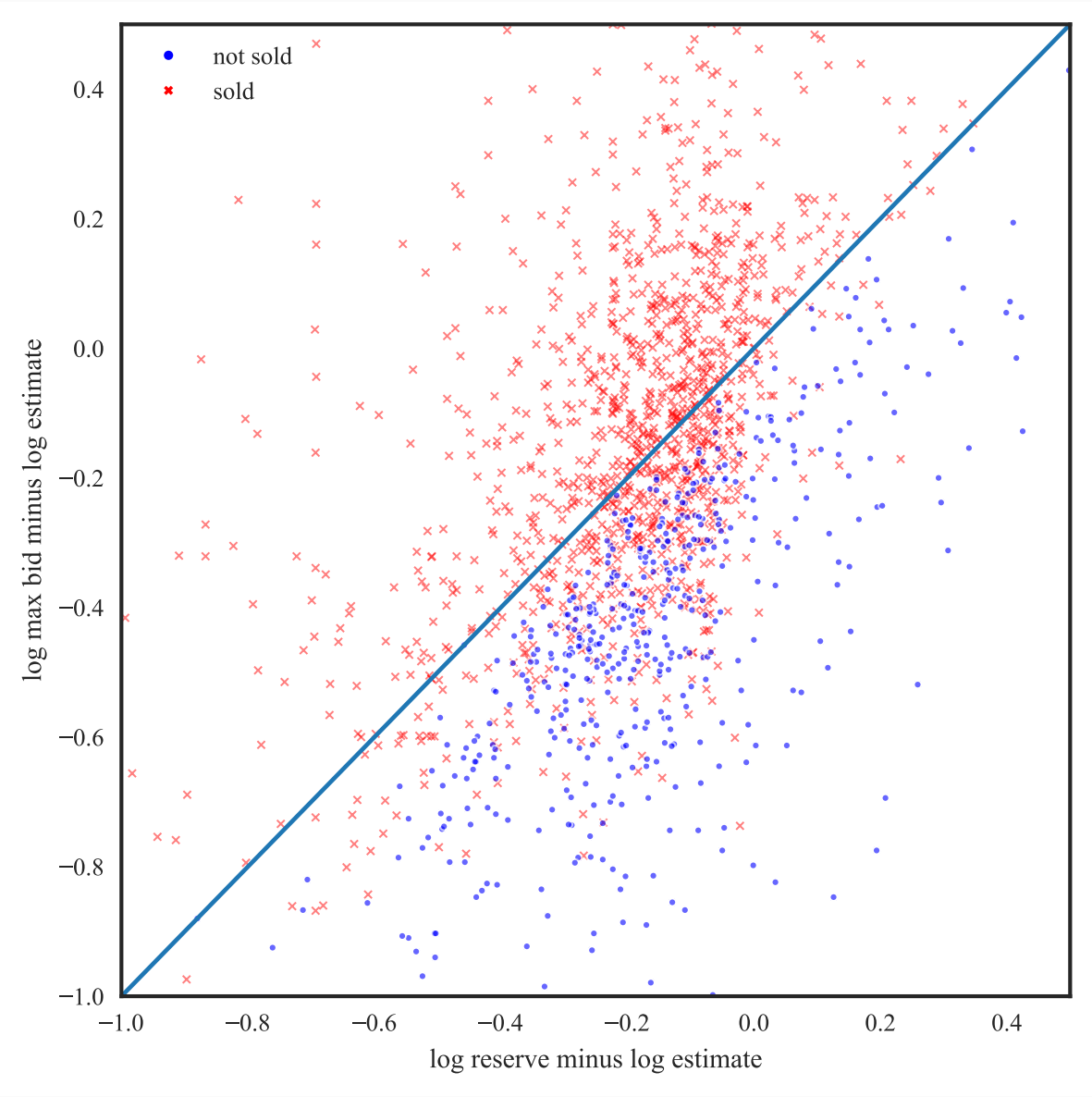
- tract characteristics
- bids (max bid in particular)
- estimate
- ex ante reserve price
- final decision

Variables



Reserve price is consistently violated...

Variables


not sold
sold
log max bid minus log estimate
log reserve minus log estimate
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−1.0
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
0.2
0.4

Main idea

Research question

Remind ourselves what's happening

1. first, an expert estimates the timber
2. second, ONF writes down the ex ante reserve price
3. then the bids are observed by the auctioneer
4. then ONF revises the reserve price up or down
5. we observe the auction outcome (sold or not sold)

The revised reserve price is not observed by the econometrician.

Question: is it possible for the auctioneer to consistently (in equilibrium) extract information from the bids? Can welfare/profit be increased?

Main idea

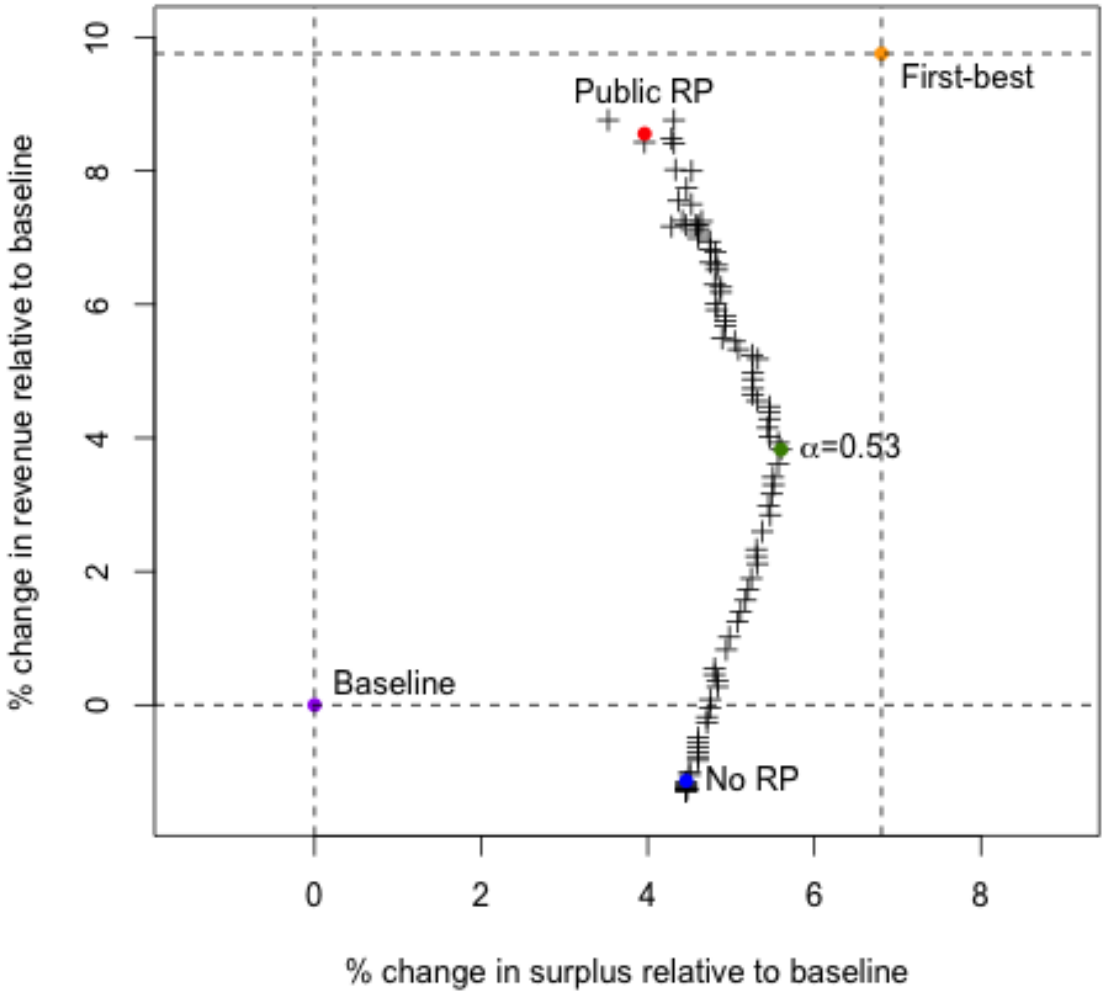
Plan of attack

1. extract the informational content from the bids
2. write a structural model: $(b - v)Pr(win|b) \to \max$
3. try ad hoc revision rules

$$r_2 = \alpha \bar{b} + (1 - \alpha) r_1, \quad \bar{b} = \sum_{i=1}^{n} b_i / n$$

4. run a bunch of MC simulations
5. compare welfare/profit

Main results



Main results

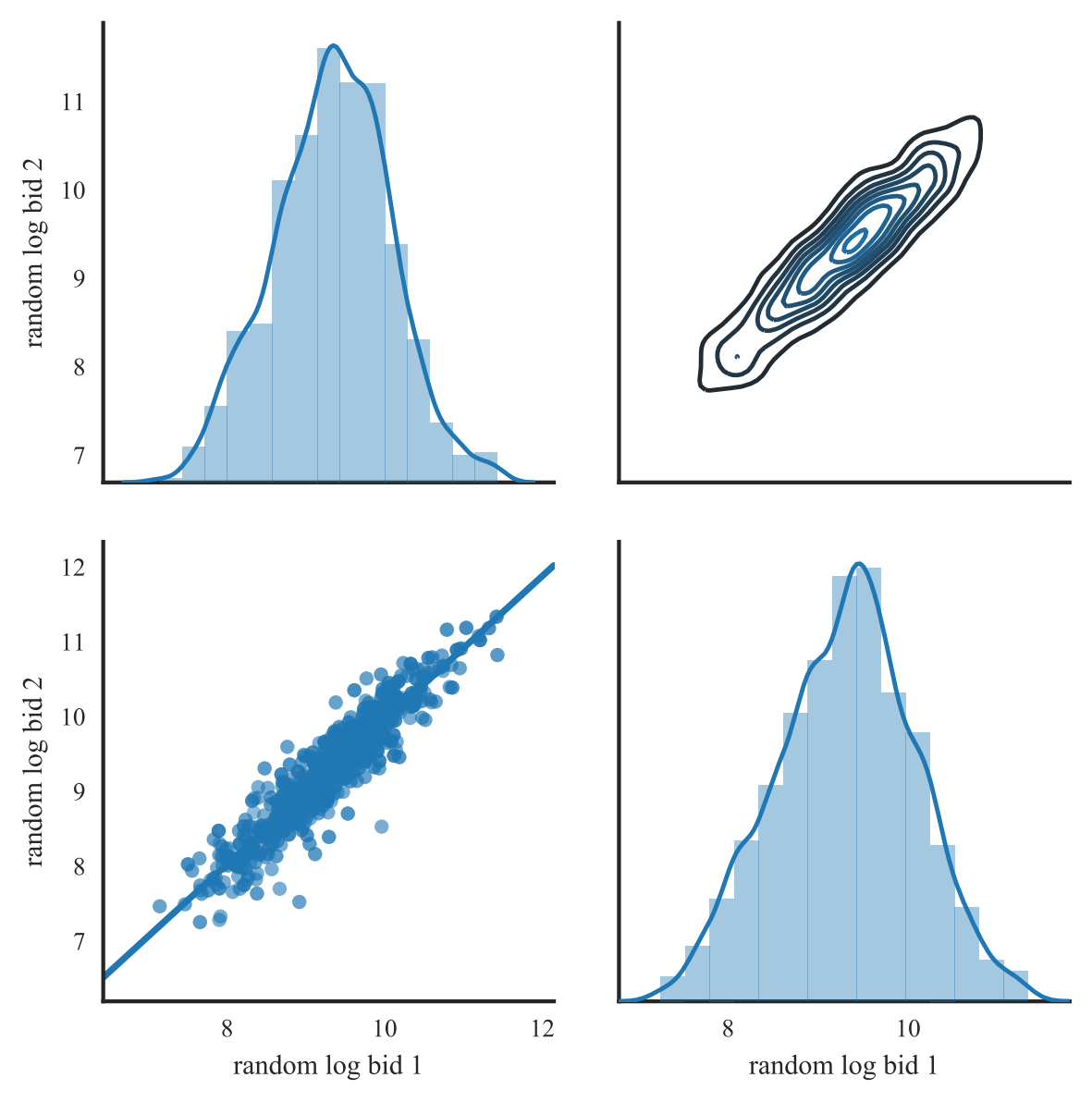
Answer: with $\alpha = 0.5$ roughly, surplus increases by 1% and revenue decreases by 2%. How can we interpret that?

- By linearly updating the reserve price, the auctioneer gets a better estimate of his own reservation value, and therefore sells more efficiently
- In the pivotal case (max bid $\sim$ ex ante reserve), a bidder has incentives to relax his bid. So, revenue should go down.

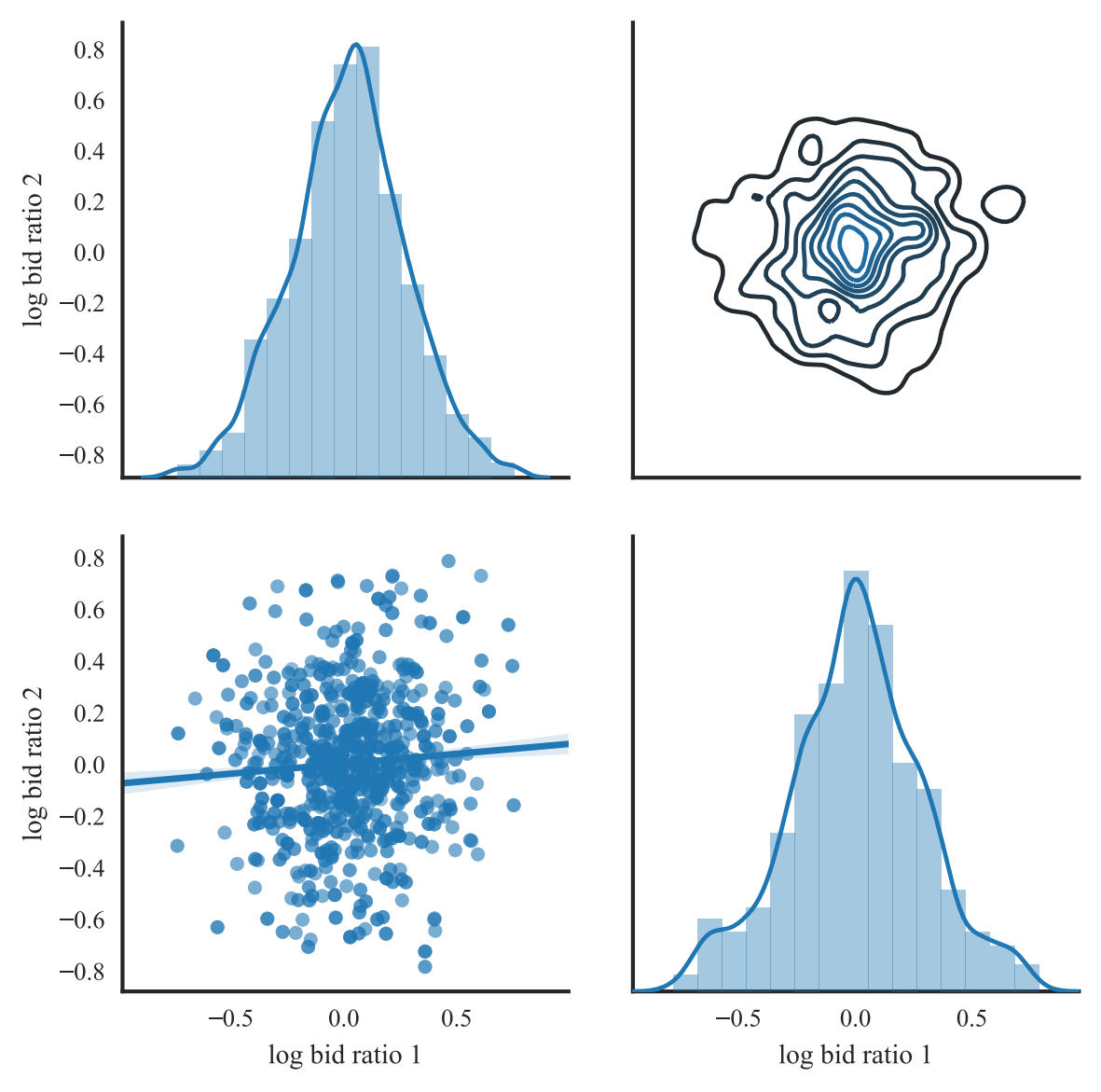
$$r_2 = \alpha \bar{b} + (1 - \alpha) r_1$$

How did we do this

Analyze bids



Analyze bid ratios



Write a model

This looks like an CIPV model:

$$V_{ij} = Y_j \cdot v_i, \quad B_{ij} = Y_j \cdot b_i, \quad R_j = Y_j \cdot (1 + \varepsilon_j)$$

where Y, v are independent and ε is the auctioneer noise term.

Then the model looks like this:

$$(b - v_i) Pr(b > \max_{j \neq i} b_j) Pr(b > \alpha \bar{b} + (1 - \alpha) r) \to \max_b$$

Solution to this problem is homogenous degree 0, while the value is homogenous degree 1 in (b, r, v). So all we need to do is solve and IPV model then multiply all utilities by $\mathbb{E}Y$. But how to extract Y?

Use deconvolution

All we need is a pair of log-bids in every auction

$$\log B_1 = \log Y + \log b_1, \quad \log B_2 = \log Y + \log b_2$$

Get to characteristic functions $\Phi(t, s)$

$$\widehat{\Phi}_{\log(Y)}(t) = \exp\left(\int_0^t \frac{\widehat{\Phi}_1(0,\xi)}{\widehat{\Phi}(0,\xi)} d\xi\right), \quad \widehat{\Phi}_{\log(b)}(t) = \frac{\widehat{\Phi}(t,0)}{\widehat{\Phi}_{\log(Y)}(t)}$$

Get back to densities

$$\widehat{f}_{\log Y}(x) = \int \widehat{\Phi}_{\log Y}(t) \exp^{-itx} dt$$

$$\widehat{f}_{\log b}(x) = \int \widehat{\Phi}_{\log b}(t) \exp^{-itx} dt$$

Extract the distribution of values

We have Y, b but we want Y, v...

Estimate the equilibrium strategy

$$\beta \in arg\max_{b}(b - v)Pr(win|b)$$

But we only observe $Pr(win|B)$... how do we get $Pr(win|b)$?

$$Pr(win|B = x) = \int Pr(win|b = \frac{x}{y})dF_Y(y)$$

Use deconvolution again (and pray that its monotone).

Mindless policy iteration

With the distributions of Y, v at hand, we can simulate almost any auction design and obtain the equilibrium strategy as a fixed point:

$$\beta^{-1}(b) \to Pr(win|b) \to \beta^{-1}(b) \to Pr(win|b) \to \beta^{-1}(b) \to \dots$$

There is not theory of contraction, but it always seems to converge in a few turns (5-10 usually).

Then integrate the auction outcomes to get revenue and welfare.

Summary

Summary

- Highlight a new rationale behind secret reserve prices
- Use French timber auctions to calibrate a model
- Through MC simulations show that at least one of the two (revenue or welfare) can be increased.
- Suggest an ad-hoc updating rule

$$r_2 = \alpha \bar{b} + (1 - \alpha) r_1$$

- Can replace $\bar{b}$ with b_{sec} or something else