

Bidding to Lose? Auctions with Resale

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- Telia did not bid in 3G auctions

Sonera won licenses in Spain, Germany, Italy and Norway

Telia took over Sonera after the auctions.

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or drop out and buy from competitor.

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and may drop out and let weak bidder win.

\Rightarrow $\left\{ \begin{array}{l} \text{Resale takes place in equilibrium,} \\ \text{gives weak bidders reason to participate and} \\ \text{increases seller's revenue.} \end{array} \right.$

Model

- Ascending auction (for a spectrum license).

– 2 bidders: $\left\{ \begin{array}{l} A \text{ is } \mathbf{strong} \\ B \text{ is } \mathbf{weak} \text{ and wealth constrained} \end{array} \right.$

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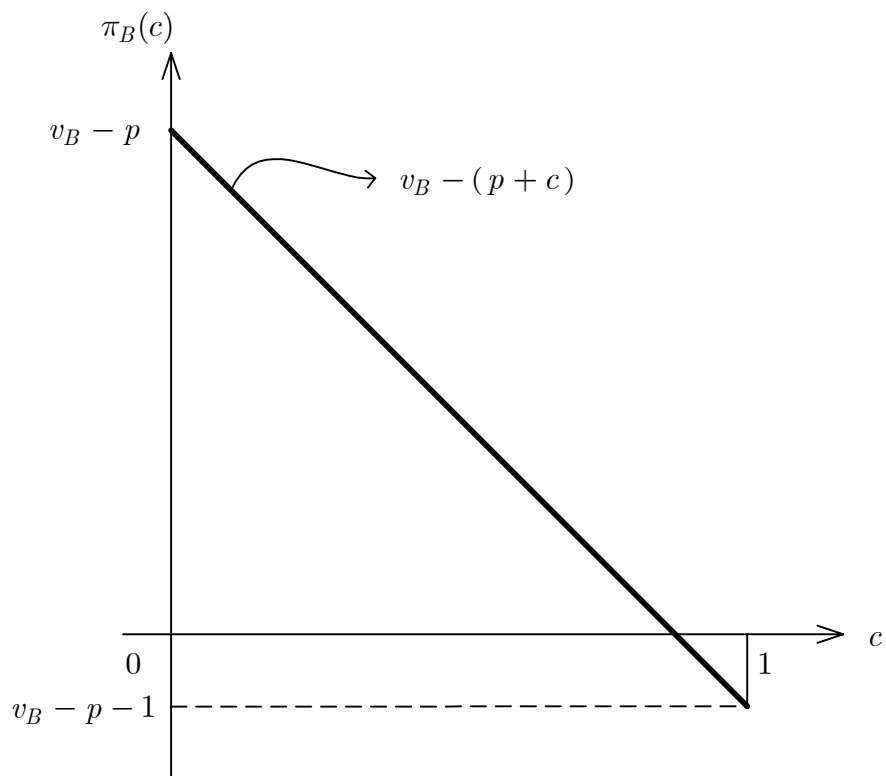
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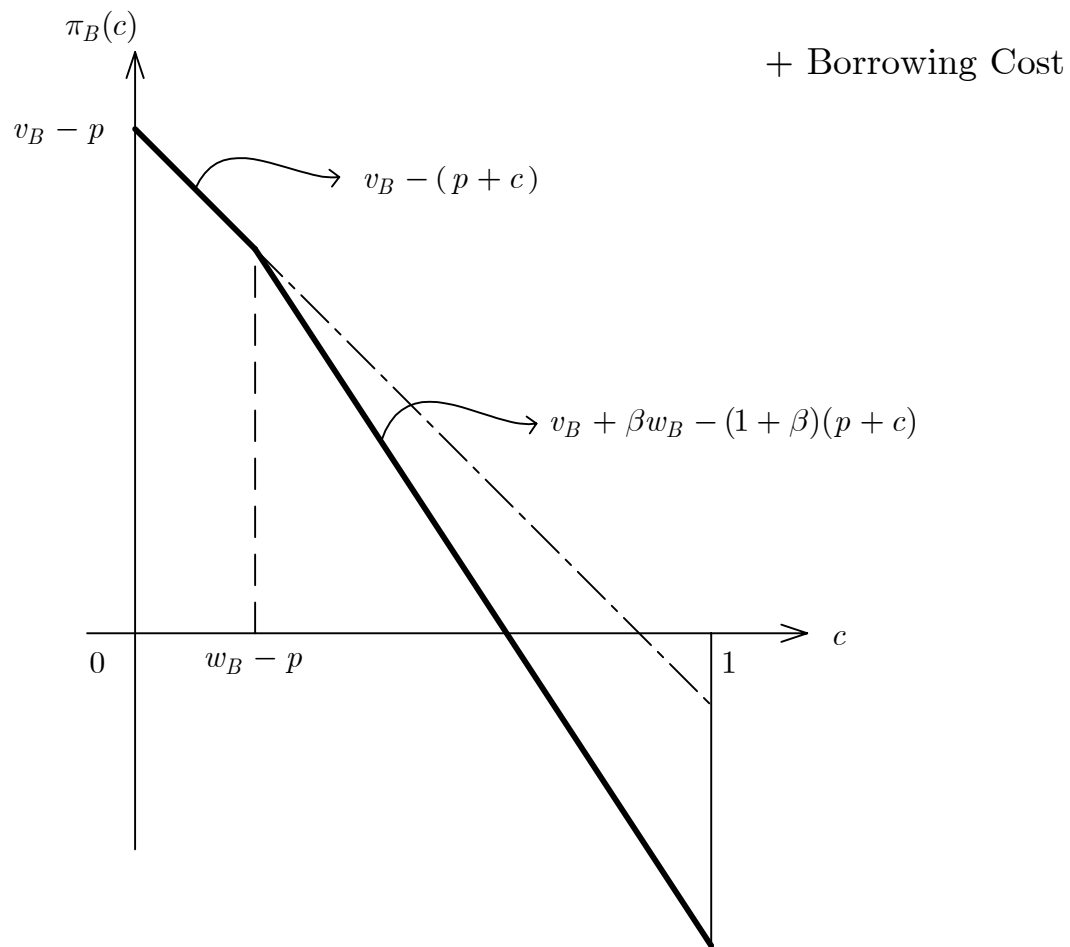
- To obtain v_i , owner pays *operating* cost $c \sim U [0, 1]$.
- To pay more than w_B , B borrows at cost β (e.g. bank interest rate).
- B 's liability is limited by w_B (cannot end up with negative wealth).

Timing

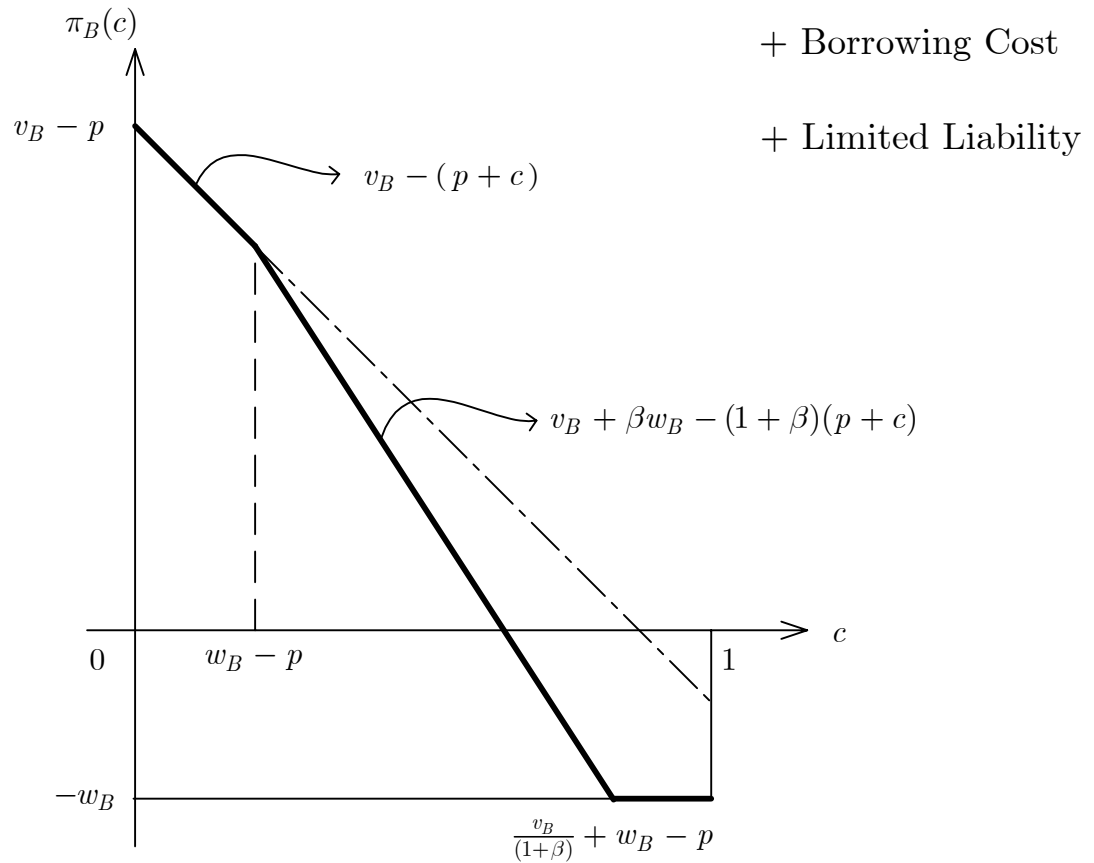
1. i wins the auction at price p (paid in stage 4).
2. *Resale* can take place.
3. Operating cost c is realized.
4. Owner of the project, j , can:
 - (i) pay $(p + c)$ to obtain v_j , or
 - (ii) go bankrupt and liquidate w_j .

Profit without Wealth Constraint

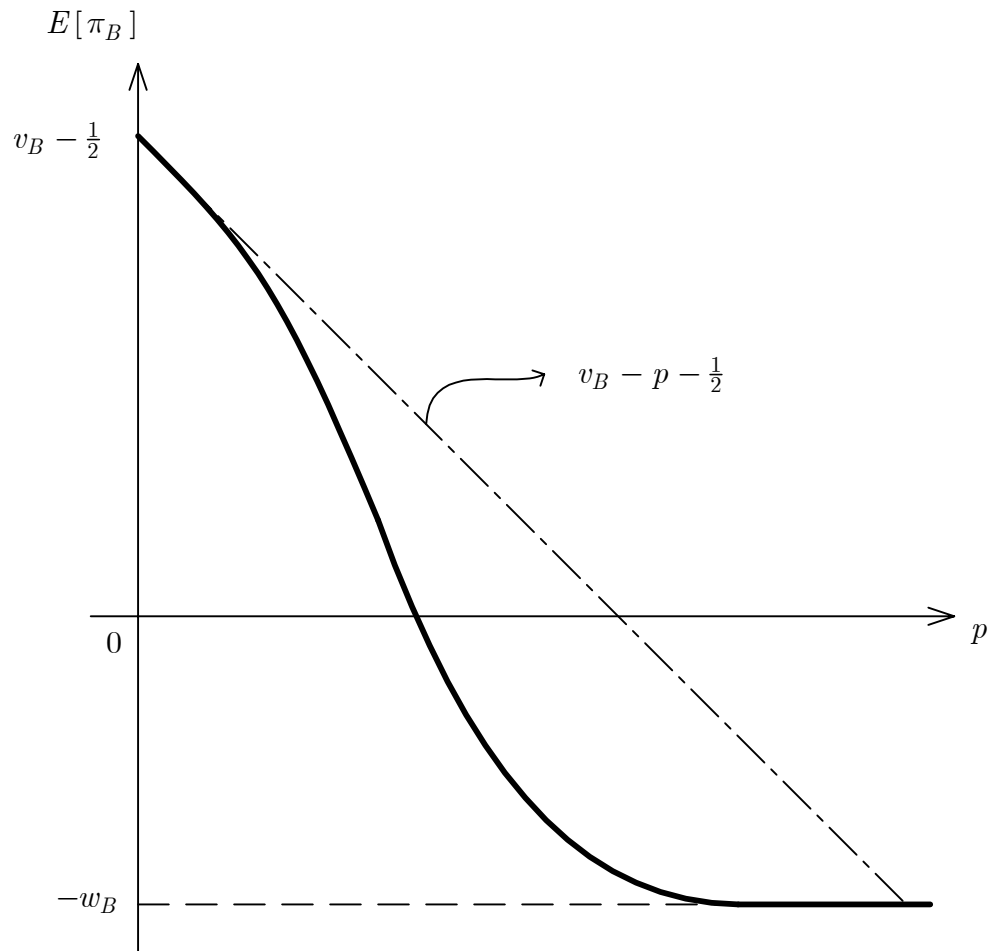




B's Profit with a Wealth Constraint



B's Expected Profit



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⇒ **Resale price** is $\frac{1}{2} (\mathbb{E}[\pi_A] + \mathbb{E}[\pi_B])$.

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$$\mathbb{E}[\pi_B(p')] = 0.$$

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$\Rightarrow p_B > p'$. ■

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$$\Rightarrow p_B > p'. \blacksquare$$

\Rightarrow A weak bidder does not drop out of the auction as soon as price reaches his valuation.

Bidding by A

- With resale, raising p makes A better off iff

$$\frac{\partial}{\partial p} (\mathbb{E} [\pi_A] - \mathbb{E} [\pi_B]) > 0 \quad \Leftrightarrow \quad \left| \frac{\partial \mathbb{E} [\pi_B]}{\partial p} \right| > \left| \frac{\partial \mathbb{E} [\pi_A]}{\partial p} \right|$$

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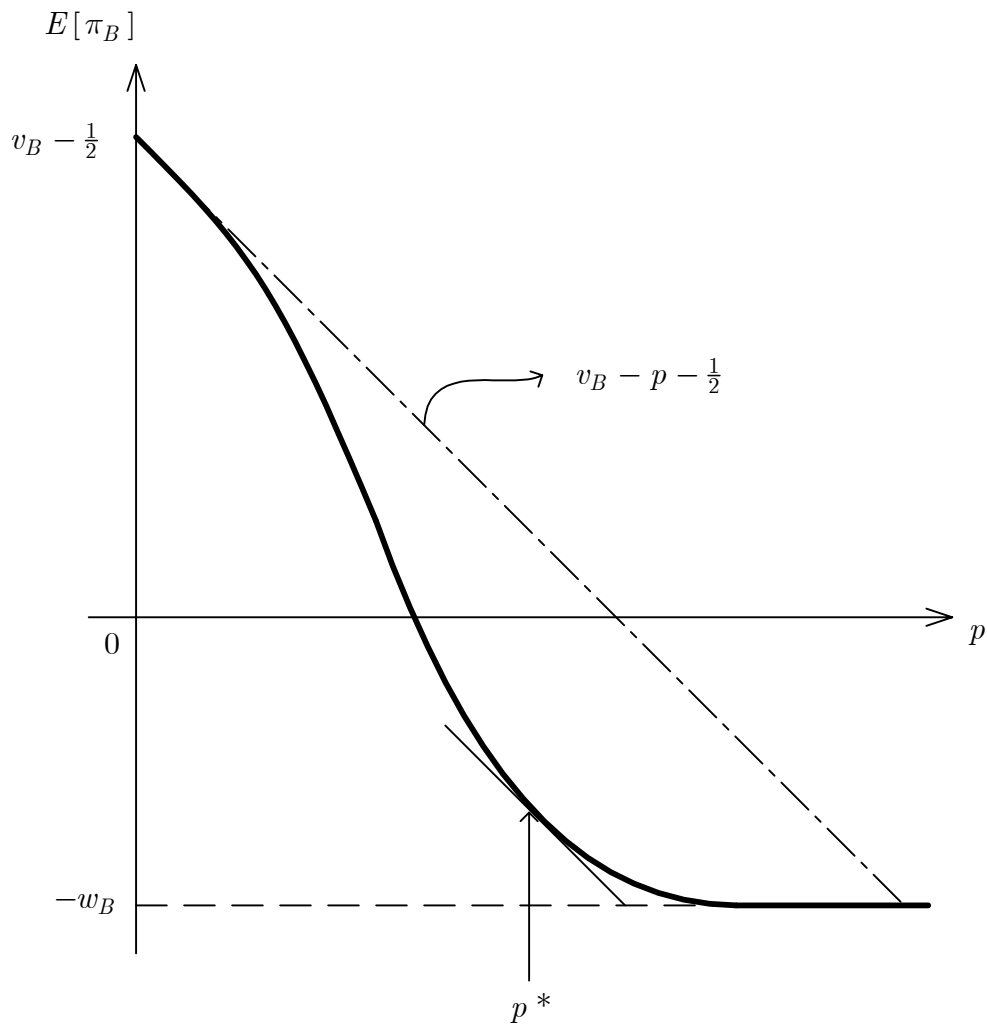
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- For high p , *Limited Liability Effect* dominates
 \Rightarrow increase in p *improves* B 's bargaining position

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- **Prop. 1** *Resale is the unique equilibrium iff:*

(i) $w_B < w^*$ and $\beta > \beta^*$, or

(ii) $w_B > w^*$ and $\beta < \beta^*$.

(Where $w^* = \frac{1}{2}(v_A - 1)$ and $\beta^* = \frac{v_B - v_A + 2w_B - 1}{v_A - 2w_B - \frac{1}{2}}$.)

Interpretation

- B bids over p^* (price at which A drops out) iff:

$$\underbrace{\mathbb{E}[\pi_B(p^*)]}_{\text{outside option}} + \frac{1}{2} \underbrace{(\mathbb{E}[\pi_A(p^*)] - \mathbb{E}[\pi_B(p^*)])}_{\text{gains from trade}} > 0$$

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⇒ Resale happens if the following are large:

- (i) $\mathbb{E}[\pi_A(p^*)]$ — **joint bidders' surplus**,
- (ii) $\mathbb{E}[\pi_B(p^*)]$ — **B 's outside option**
(which determines B 's share of joint surplus).

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- For **large** w_B :

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\Rightarrow Resale happens for $\begin{cases} \text{low } \beta \text{ if } w_B \text{ is large} \\ \text{high } \beta \text{ if } w_B \text{ is small} \end{cases}$

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\Rightarrow **Prop. 2** *When resale takes place,
seller reduces β and increases w_B to raise p^* .*

But to induce resale, seller $\left\{ \begin{array}{l} \text{reduces } \beta \text{ if } w_B \text{ is high,} \\ \text{increases } \beta \text{ if } w_B \text{ is low.} \end{array} \right.$

Extensions

- No entry cost
- More bidders
- Different bargaining
- Auction price paid before resale
- Returning the prize

Conclusions

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- In EU 3G auctions resale was difficult, this may have discouraged weak bidders from entering and resulted in lower governments' revenue.

No Entry Cost

- Assume weak bidder always participates (bidding is costless).

⇒ Without resale, auction price is p' s.t.:

$$\mathbb{E}[\pi_B(p')] = 0.$$

⇒ Auction price is higher with resale if $p^* > p'$.

- **Proposition 3** *If weak bidder always enters, resale raises auction price iff $2w_B(1 + \beta) > 1$.*

– High w_B reduces limited liability effect $\Rightarrow p^* \uparrow$.

– High β reduces B 's profit $\Rightarrow p' \downarrow$.

Example

- 2 bidders: A has value $v_A = 10$
 B has value $v_B = \begin{cases} 5 & \text{pr. } \frac{1}{2} \\ 3 & \text{pr. } \frac{1}{2} \end{cases}$
- B 's wealth is $w_B = 0$ — *limited liability*
 \Rightarrow After winning at price p , B 's profit is:

$$\mathbb{E}[\pi_B] = \frac{1}{2} \max\{5 - p; 0\} + \frac{1}{2} \max\{3 - p; 0\}.$$

- B resells to A after winning the auction,
 and bidders share resale surplus $\pi_A - \mathbb{E}[\pi_B]$.
- At what price does A drop out?

p	$\pi_A = v_A - p$	$\mathbb{E}[\pi_B]$	$\pi_A - \mathbb{E}[\pi_B]$
0	10	4	6
1	9	3	6
2	8	2	6
3	7	1	6
4	6	$\frac{1}{2}$	$5\frac{1}{2}$
5	5	0	5
6	4	0	4

$\Rightarrow A$ never bids more than 3.

- Does A prefer any price ≤ 3 ?
- Assume B pays βp to bid above w_B , $0 < \beta < \frac{1}{4}$.

p	$\pi_A = v_A - p$	$\mathbb{E}[\pi_B]$	$\pi_A - \mathbb{E}[\pi_B]$
0	10	4	6
1	9	$3 - \beta$	$6 + \beta$
2	8	$2 - 2\beta$	$6 + 2\beta$
3	7	$\frac{1}{2}(2 - 3\beta)$	$6 + \frac{3}{2}\beta$
4	6	$\frac{1}{2}(1 - 4\beta)$	$5\frac{1}{2} + 2\beta$
5	5	0	5
6	4	0	4

$\Rightarrow A$ prefers price 2.

- Questions:
 - Does B bid up to 2?
 - Does A prefer resale to winning the auction?
 - What if $w_B > 0$?
 - Seller's revenue?

Auction Price Paid before Resale

- $v_A = 10$; $w_B = 5$; $v_B = \begin{cases} 2 & \text{pr. } \frac{1}{2} \\ -2 & \text{pr. } \frac{1}{2} \end{cases}$

\Rightarrow After winning at price p , B 's value is:

$$\mathbb{E}[v_B] = \frac{1}{2} \cdot 2 + \frac{1}{2} \cdot \begin{cases} \max\{-2, -w_B\} & \text{if } p < w_B \\ 0 & \text{if } p \geq w_B \end{cases}$$

- B cannot bid more than w_B .

p	$w_B - p$	$\mathbb{E}[v_B]$	$S = v_A - \mathbb{E}[v_B]$
0, 1, 2	> 2	0	10
3	2	0	10
4	1	$1 - \frac{1}{2} = \frac{1}{2}$	$9\frac{1}{2}$
5	0	1	9
6	X	X	

- B bids up to 6
(after winning at 5, B 's surplus is $1 + \frac{1}{2}9 > 5$).
- A can win at price 6 and obtain 4 *or*
drop out at price 3 and obtain $\frac{1}{2}10$ with resale.

$\Rightarrow B$ wins at price 3.

Resale with Fixed Mark-up

- $v_A = 5$; $v_B = 0$.
- B 's managers resell at price $p + k$, say $k = 1$
(e.g. to justify strategy with shareholders).

p	$\pi_A = v_A - p$	$S_A = v_A - (p + 1)$
0	5	4
1	4	3
2	3	2
3	2	1
4	1	0
5	0	-1

- B bids up to $v_A - 1 = 4$ (max p at which he resells).
- A can win at price 4 and obtain 1 *or*
drop out earlier and buy in resale market.

$\Rightarrow A$ drops out at $p = 0$.

European 3G Ascending Auctions (in date order)

	number of bidders
UK	13
Netherlands	6
Germany	7
Italy	6
Austria	6
Switzerland	4
Belgium	3
Greece	3

- After UK auction, bidders learned relative valuations.

⇒ If bidders expect to lose, they do not participate.