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# Competitive procedures in procurement: auctions and scoring rules

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# Structure

- Why a scoring rule
  - Equivalent monetary value of quality (ME)
  - Monetary value of points (MVP)
  
- Common scoring rules
  
- Scoring rules and further issues
  - Penalty
  - Quality

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# Why a scoring rule (1/5)

- Quality/Price Trade-off
  - Quality is costly
- Willingness to pay for quality
- Translate the value of price-quality pairs into economic/technical weights

# Why a scoring rule (2/5)

- **Most Economically Advantageous Tender (MEAT) and Scoring rule:**
  - Ex. Art 95 Italian Public Procurement Code (evaluation criteria)
  - Suppliers offer the price (economic part of the offer) and some technical aspects of the service/good to deliver (technical part of the offer)
  - SR is a function assigning a score to the mix of economic and technical part of the offer)
  - SC defines the buyer's preference over price and quality, reveals this preference to the competitors

# Why a scoring rule (3/5)

$$\text{total score} = ES + TS$$

- Low price-high ES; high quality-high TS
- ES and TS reveal the buyer's preference (importance, willingness to pay for) over quality and price

# Why a scoring rule (4/5)

- Different scoring rules select different winners
  - 50 points for economic and technical offer
  - Economic offer: discount in % (d) of the reserve price (200)

$ES = d \times 50$	A	B	C	$ES = \frac{d \times 50}{d_{max}}$	A	B	C
Discount	10%	15%	35%	Discount	10%	15%	35%
Quality score	20	10	7	Quality score	20	10	7
TS	25	17.5	24.5	TS	34.3	31.4	57

- *i. e.*:  $ES(A) = 50 \times 0.1 = 5$        $ES(A) = \frac{0.1 \times 50}{0.35} = 14.3$

# Why a scoring rule (5/5)

- To solve the quality-price trade-off the buyer must transform his preferences (technical-economic targets) into a specific scoring rule
  - Each scoring rule represents a specific buyer's preference
  - Scoring rule is a signal to the competitors about the buyer's preference
  - MVP and ME measure these preferences

# ME and MVP (1/2)

- ME: price the buyer is willing to pay for an increase of quality from the minimum required
  - Equivalent monetary value of additional quality improvements
- MVP: money the competitor must give up (price reduction) to get one more point
  - Cost of price-competition
  - Incentive to quality competition

# ME and MVP (2/2)

- Maximum points: 50 (ES)+50 (TS)

	Firm A	Firm B
Price-offer	100,000	110,000
Awarded (EC) points	50	40

- Value of each point is  $10,000/10=1000$  (MVP)
- MVP independent from the price-bid
- The Higher the MVP the higher the cost of each point
  - The higher the incentive to compete on quality

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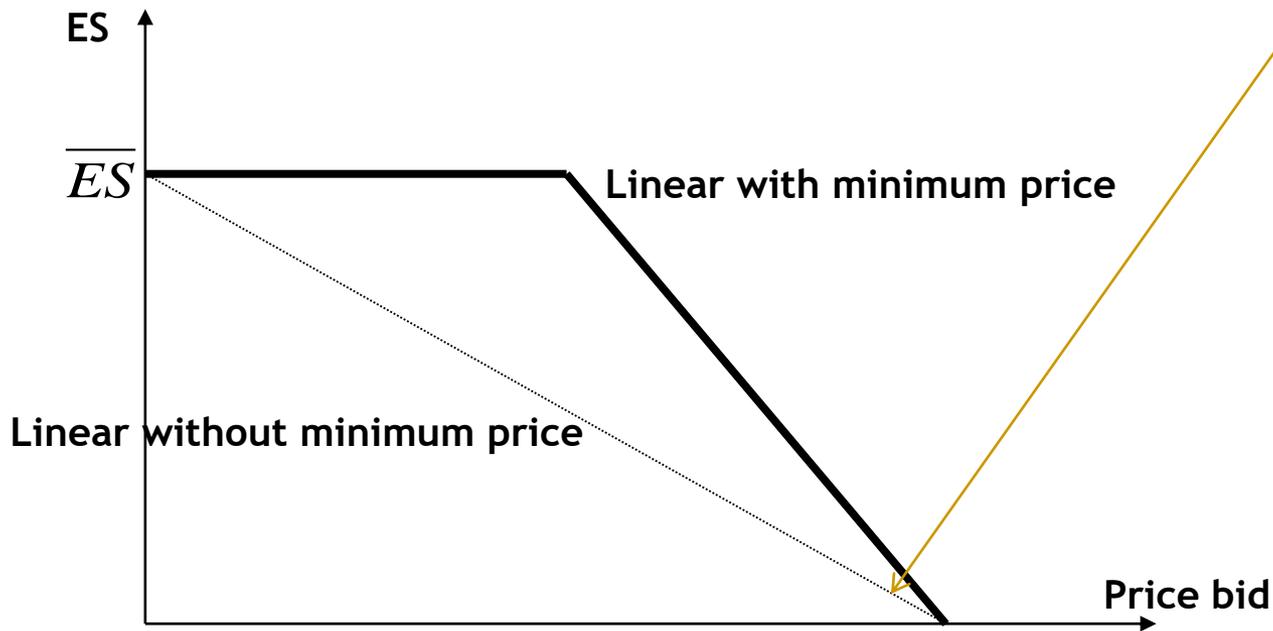
# Common scoring rules

- Independent
  - Linear
  - Parabolic
  
- Interdependent
  - $P_{min}$
  - $P_{min}, P_{max}$
  - *Mean*

# Linear scoring rule in practice (1/5)

$$ES = \begin{cases} \overline{ES} \times \frac{P_r - P_o}{P_r - P_m}, & P_r \geq P_o \geq P_m \\ \overline{ES}, & P_o < P_m \end{cases} \Rightarrow ES = \overline{ES} \times \frac{P_r}{P_r - P_m} - \frac{\overline{ES}}{P_r - P_m} \times P_o$$

$P_m$  = minimum price;  $P_r$  = reserve price;  $P_o$  = price bid



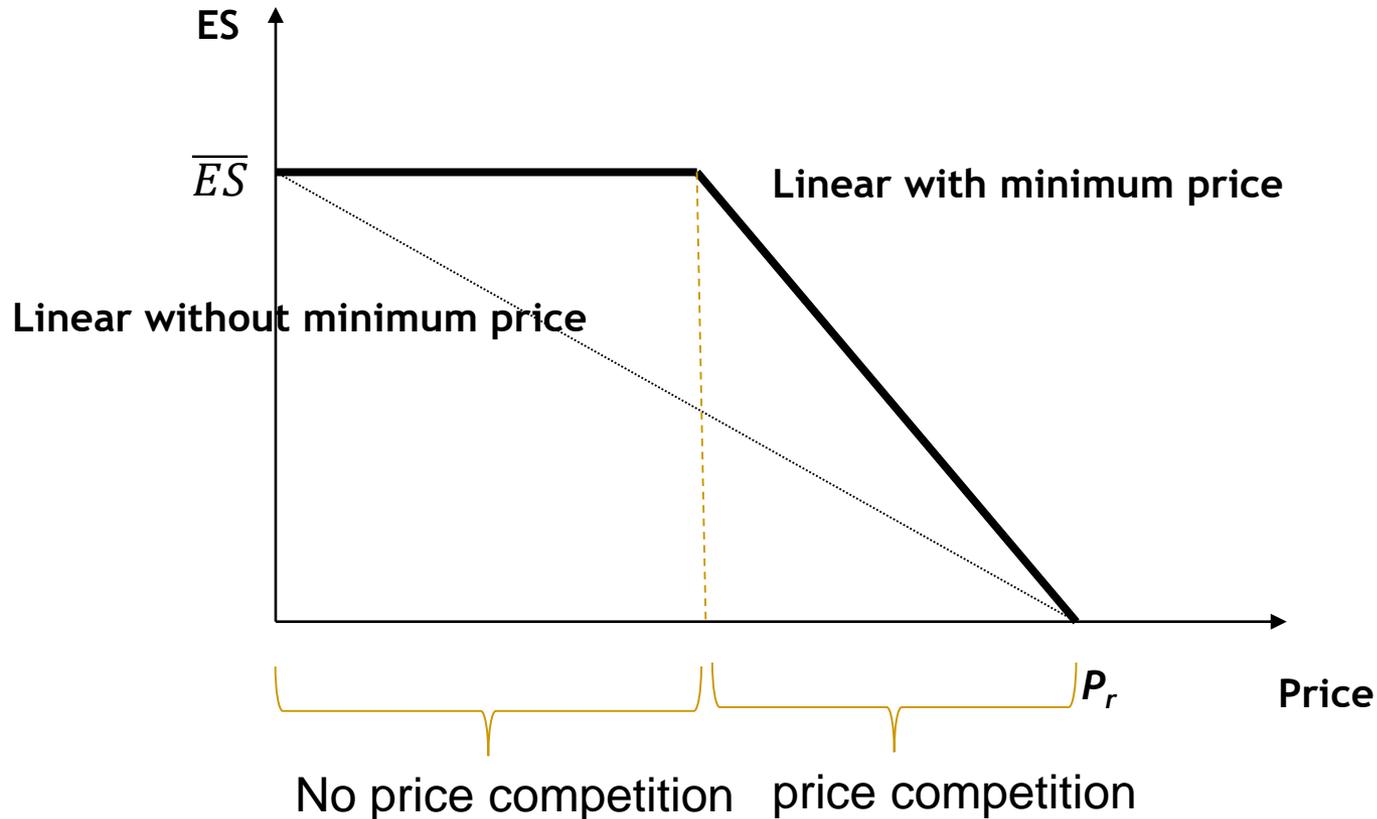
# Linear scoring rule in practice (2/5)

- Constant MVP (independent from the price bid)

$$MVP = \left[ \left( \frac{P_r - P_m}{\overline{ES}} \right) \right] = \left[ \left( \frac{d_{\max}}{\overline{ES}} \right) \right]$$

- MVP increases (quality more important):
  - When reserve price increases (less aggressive rp);
  - When  $\overline{ES}$  decreases;
  - When minimum price decreases
- The minimum price is used to affect price competition

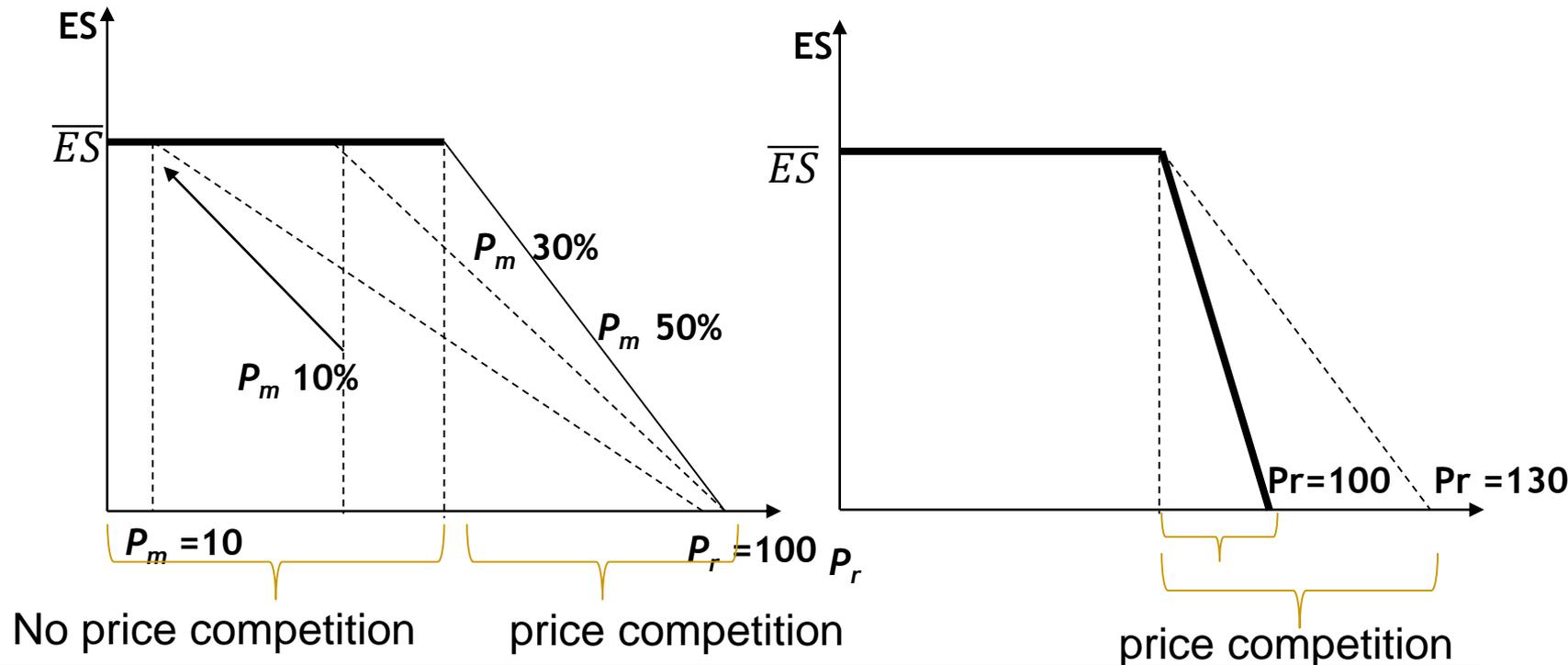
# Linear scoring rule in practice (3/5)



# Linear scoring rule in practice (4/5)

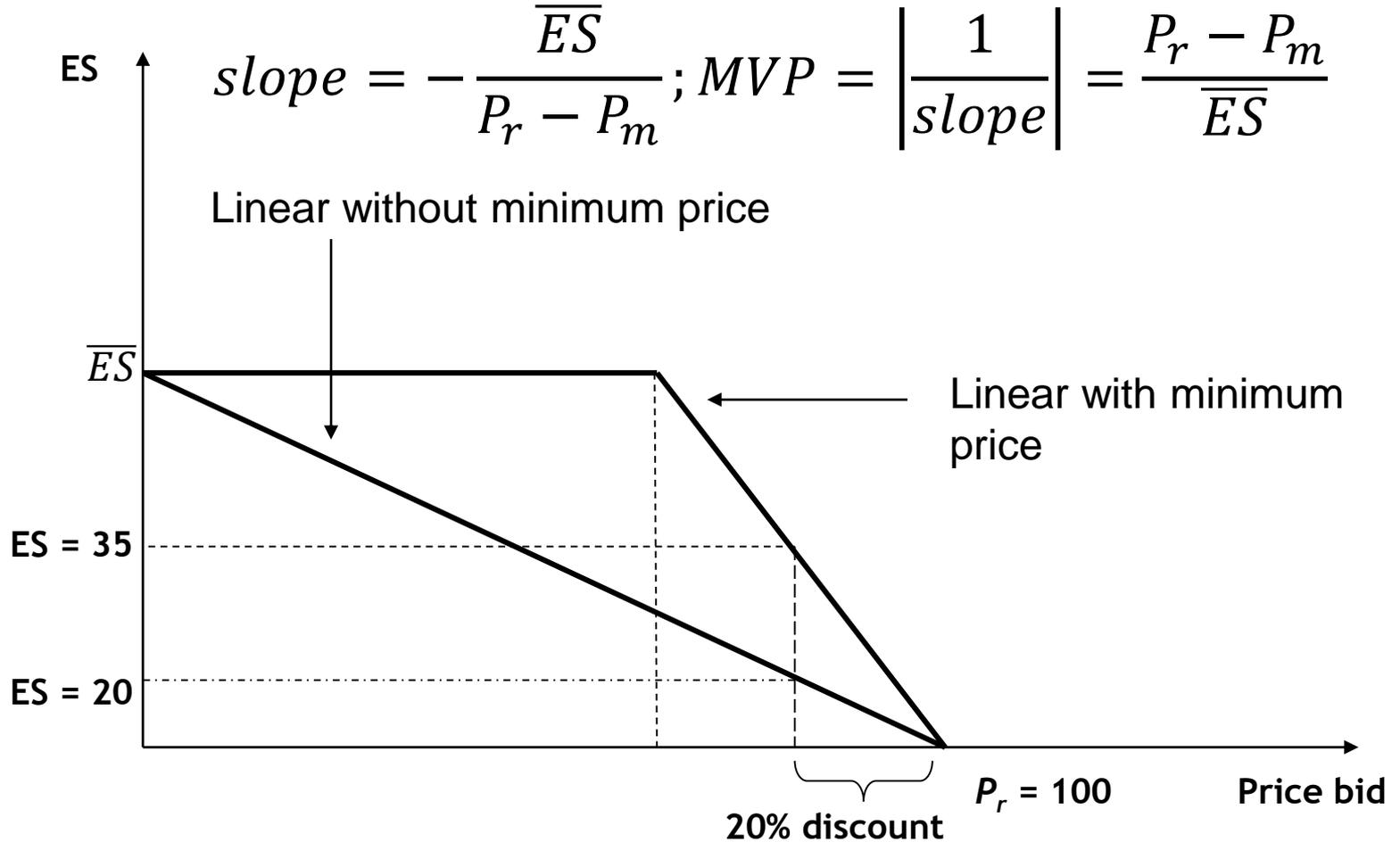
A Variation in the minimum price (given the reserve price) affects competition only for the prices higher than the minimum

Variation in the reserve price (given the minimum price)



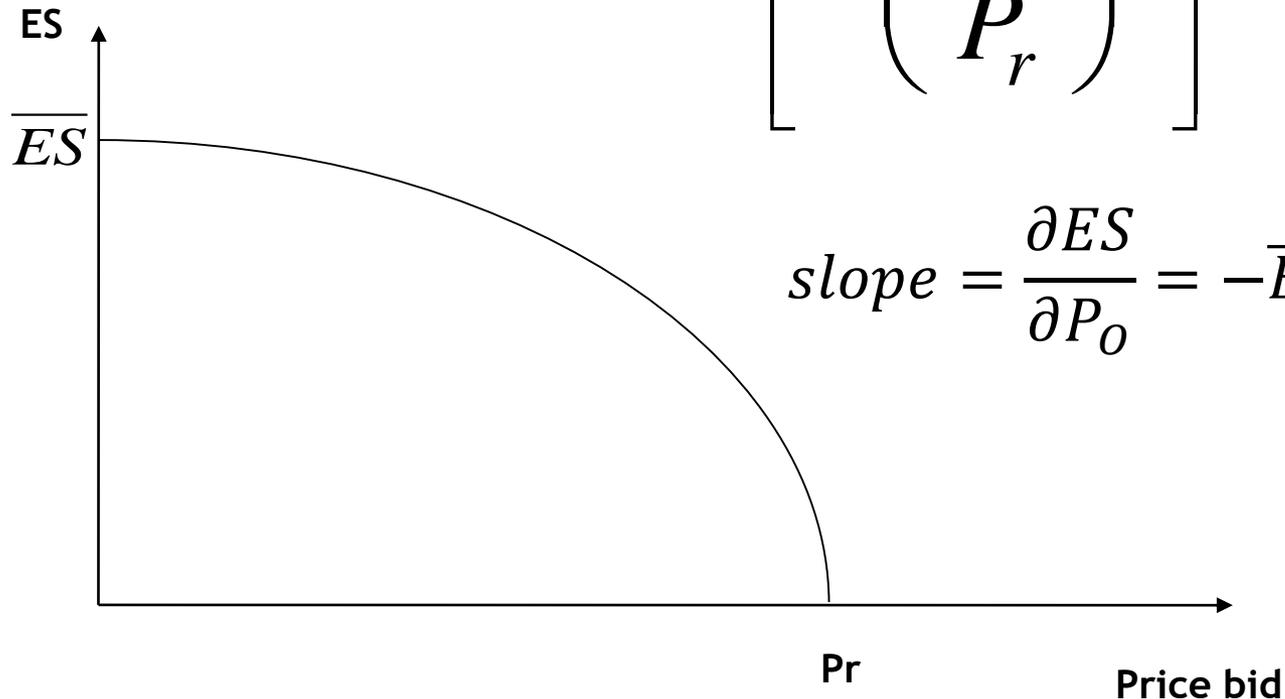
# Linear scoring rule in practice (5/5)

- More competition on the prices above the minimum



# Parabolic scoring rule (1/3)

$$ES = \overline{ES} \times \left[ 1 - \left( \frac{P_o}{P_r} \right)^x \right]$$



$$\text{slope} = \frac{\partial ES}{\partial P_o} = -\overline{ES} \frac{x}{P_o} \left( \frac{P_o}{P_r} \right)^x$$

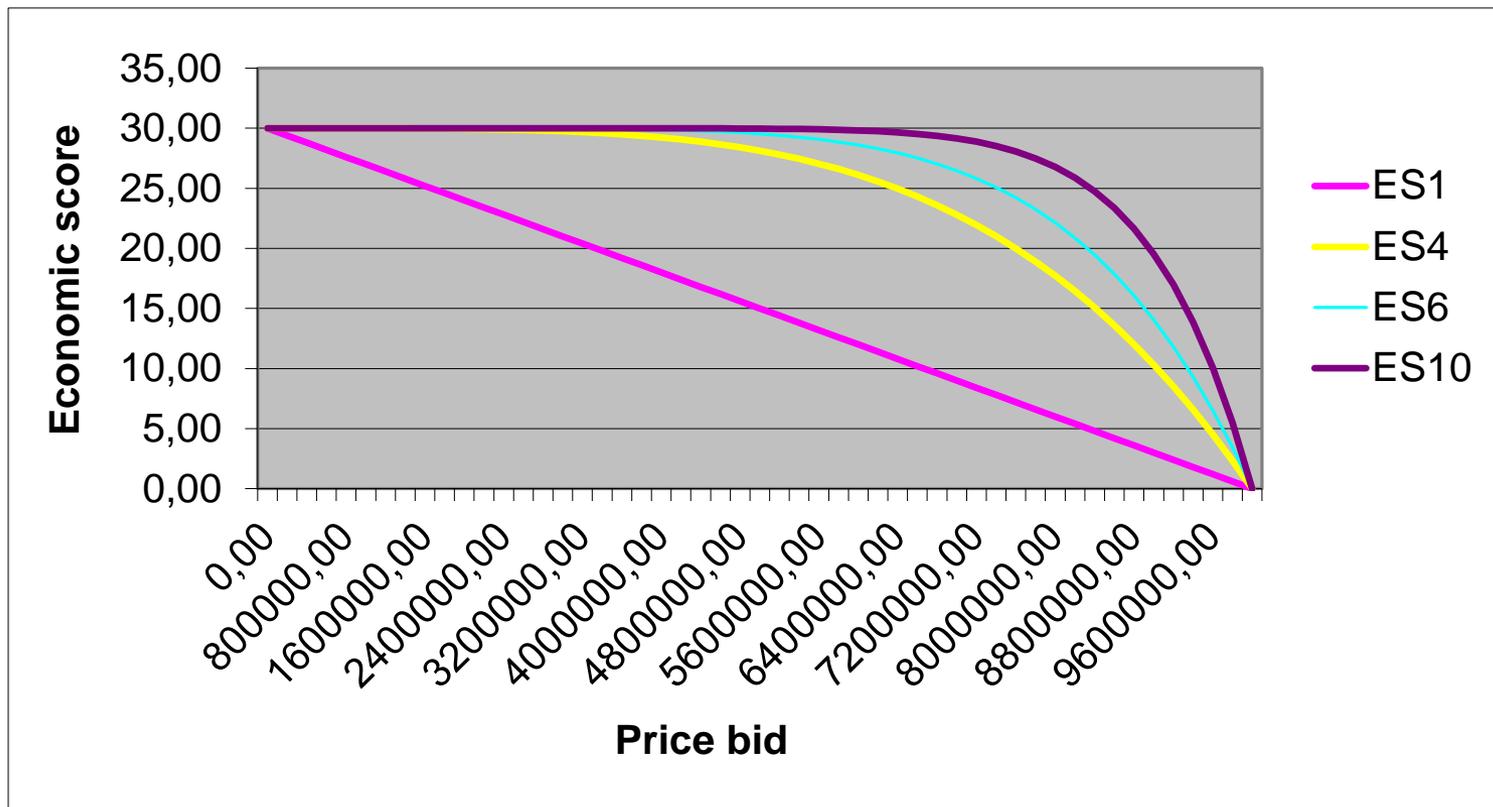
# Parabolic scoring rule (2/3)

- MVP is decreasing in the price.
  - The importance of the quality decreases in the price bid
  - More price competition close to the reserve price.



# Parabolic scoring rule (3/3)

- ❑ X is set to fine tune price-quality competition
- ❑ Reduce incentive for excessive low-price bid



# Interdependent scoring rules

## Advantages

No requirement about the reserve price

## Drawbacks

Score uncertainty:

- Impossible to **calculate** MVP ex-ante (price/quality preference not defined by the buyer);
- More potential **difficulties** for the competitors to set the offer;
- Risk of “**manipulation**” of the scoring rule;

# Interdependent scoring rules: $P_{min}$

$$ES = \overline{ES} \times \frac{P_{\min}}{P_o} \text{ or } \overline{ES} \times \frac{d_o}{d_{\max}},$$

- ❑ All points are assigned
  - The highest score to the best offer
- ❑ The score depends on the «best» offer
- ❑ When the best offer is rejected (anomalous), the new ranking may change unpredictably.
- ❑ Aggressive bids (when competitors expect to bid the lowest price)

# Interdependent scoring rules: $P_{max}, P_{min}$

$$ES = \overline{ES} \times \frac{P_{max} - P_o}{P_{max} - P_{min}}.$$

- All points are assigned
- Very aggressive bids
  - The lowest price gets the max score
  - The highest (even marginally) bid gets zero

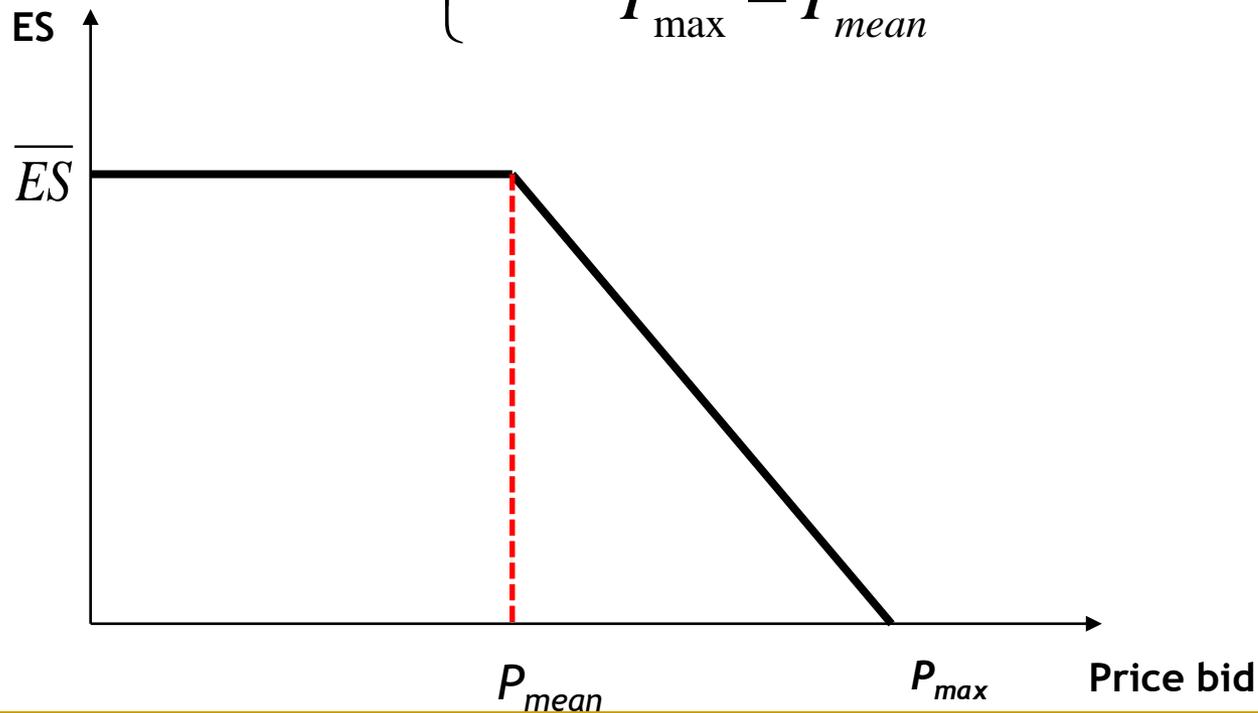
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# Interdependent scoring rules: mean

- Two possible scoring rules:
    1. The offer closest to the mean gets the max score, with the others receiving the score according to their distance from the mean
    2. The offer below the mean gets the maximum score
      - Equivalent to a linear scoring rule with endogenous minimum price
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# Interdependent scoring rules mean: second type (1/2)

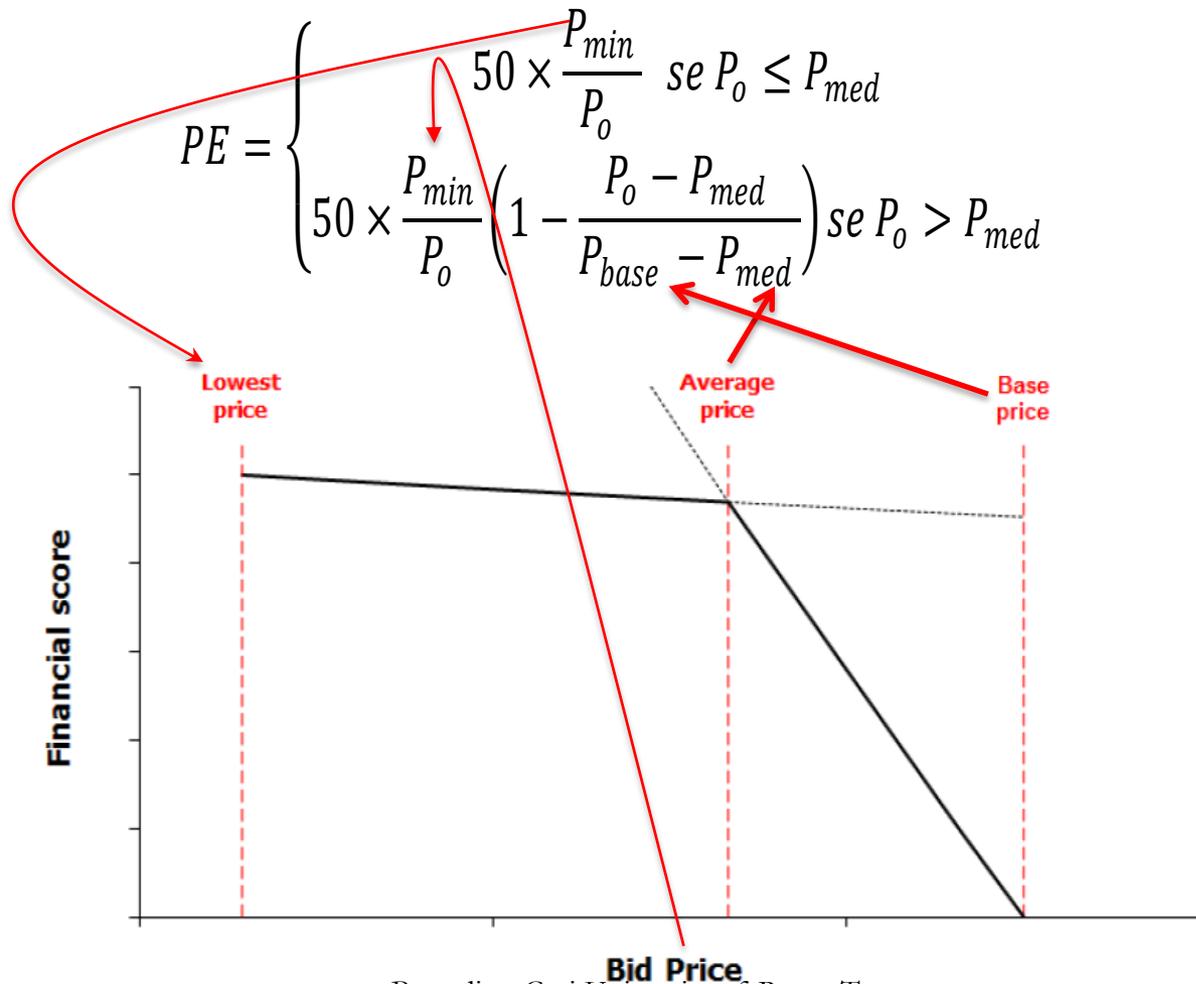
$$ES = \begin{cases} \overline{ES}, & P_o < P_{mean} \\ \overline{ES} \times \frac{P_{max} - P_o}{P_{max} - P_{mean}}, & P_o \geq P_{mean} \end{cases}$$



# Interdependent scoring rules mean: second type (2/2)

- Limits aggressive price-bids
  - Avoids *ex post* quality undercutting
- High procurement costs
  - Incentive to bid prices on the mean instead of aggressive pricing
- Exposed to coordination/manipulation
  - Groups of competitors may manipulate the mean
    - Small size group more willing to manipulate
    - Price-Efficient firms (able to offer high discounts)

# The Pellegrini-Consip case: scoring rule



# The Pellegrini-Consip case: scoring rule

- Consider the rebate bid (with respect of the reserve price). Rebates in the horizontal axis and score in the vertical axis

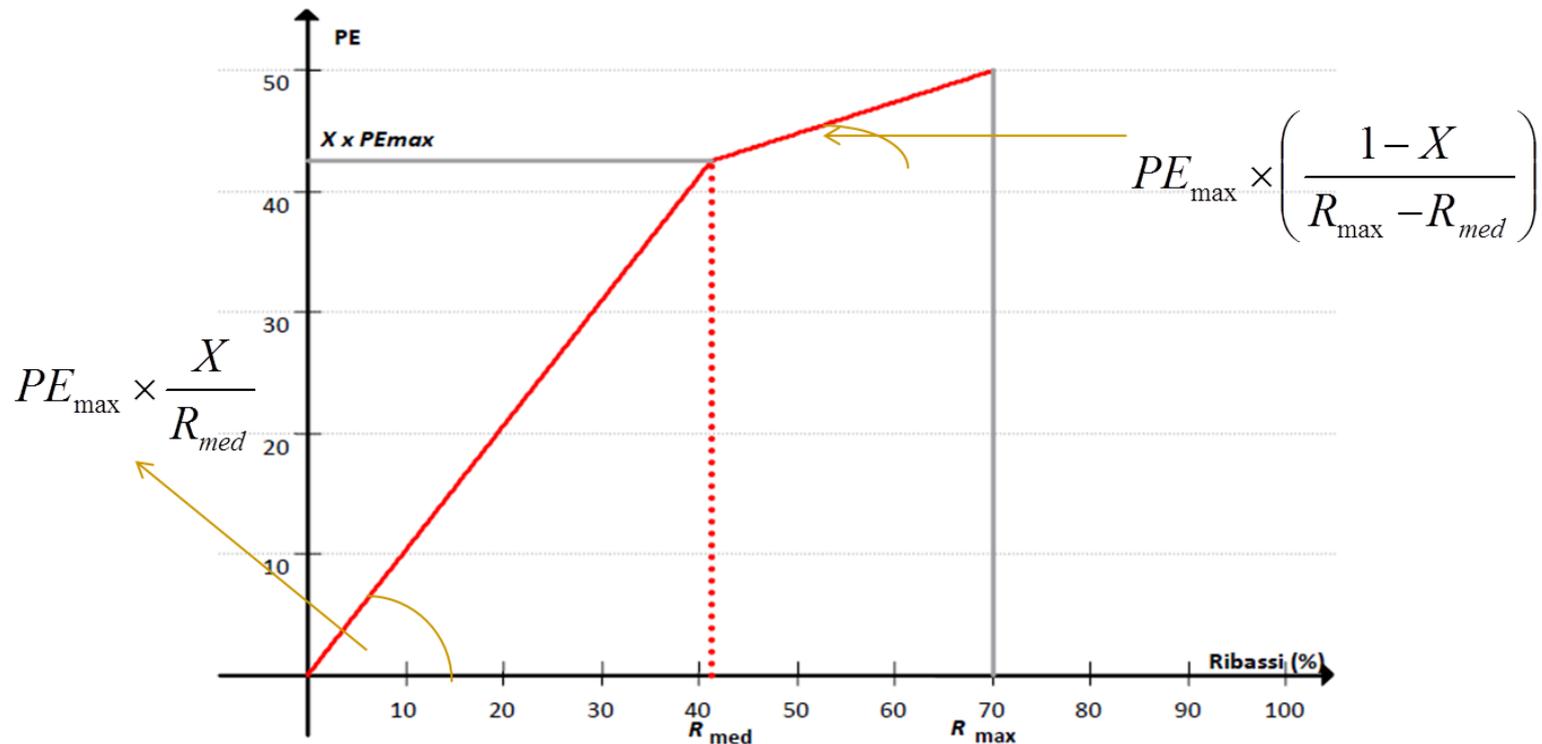
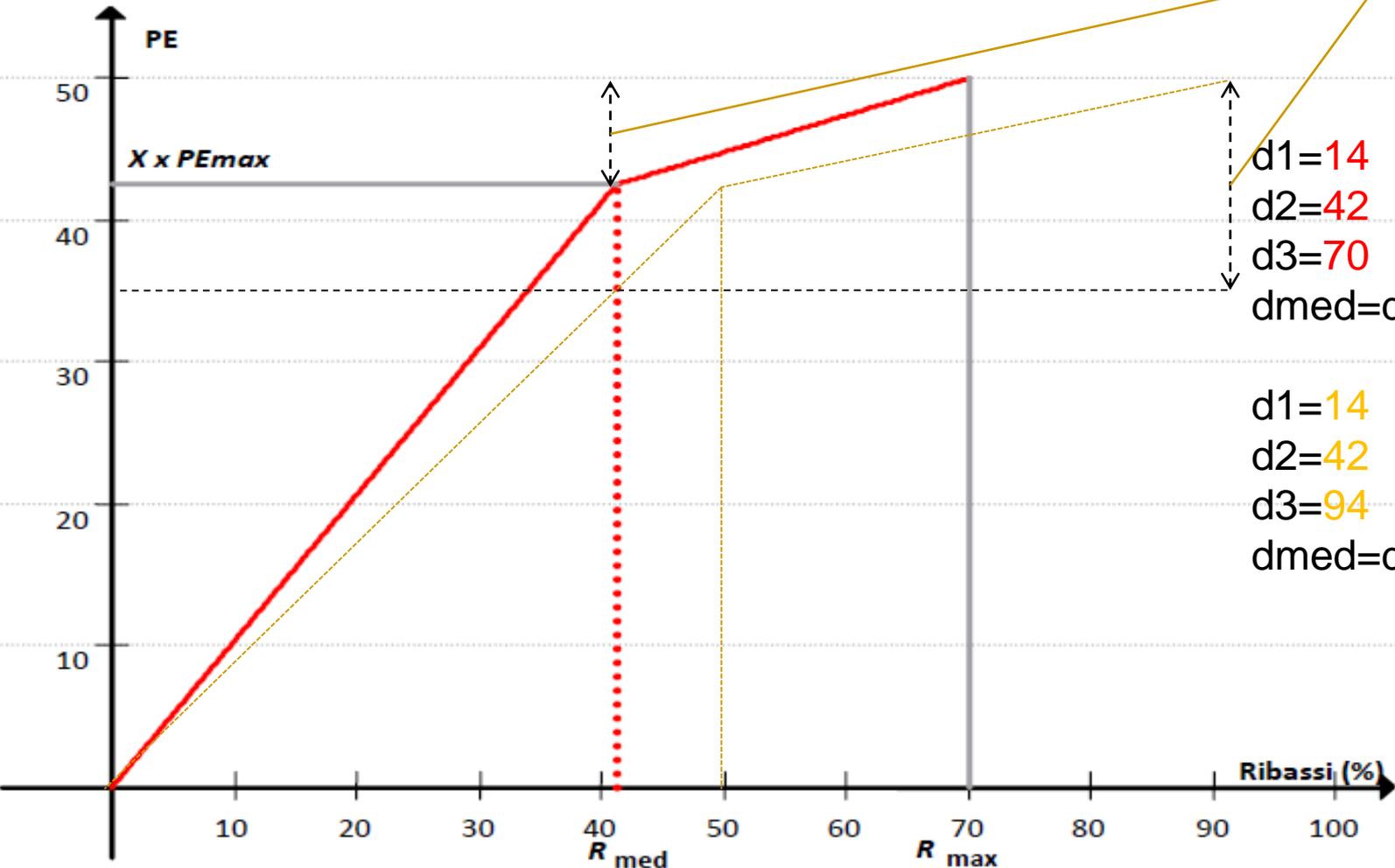


Figura 4. La formula “spezzata al prezzo medio”. La quota  $X=85\%$  del punteggio totale è attribuita in corrispondenza della media dei ribassi offerti in gara. Si noti come, nell’esempio in figura, il grafico della spezzata risulta concavo (pendenza del primo tratto superiore alla pendenza del secondo tratto).

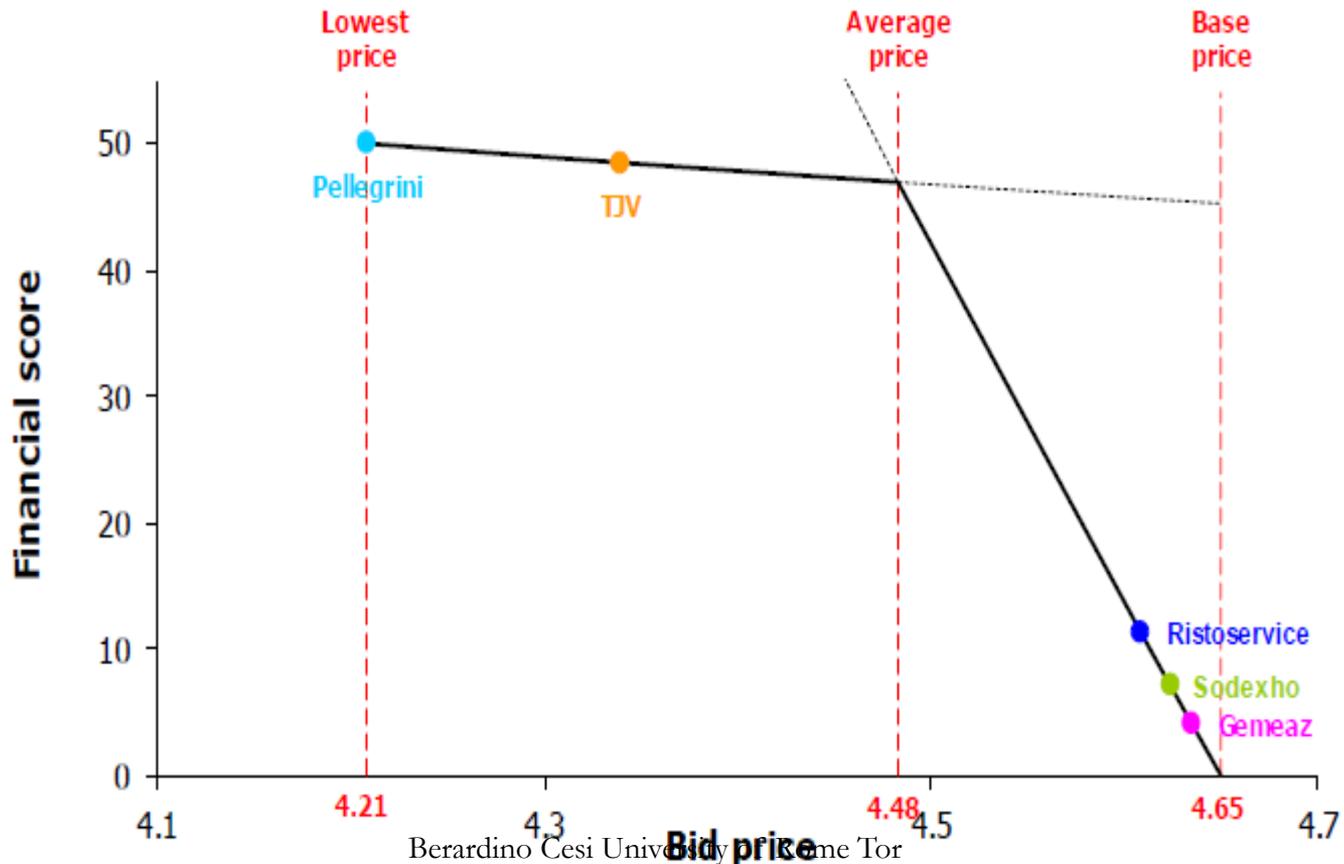
# Scoring rule strategic manipulation

- Assume bidder 1 and 2 agree on manipulating the scoring rule
- 2 out of 3 participants can (definitely) affect the average bid
  - that in turn determines (within the scoring rule) the assignment of the score
  - Bidder 3 can offer an “artificially high” discount
    - ...so that firm 2’s bid falls far from the average discount (much lower)
    - this behaviour narrows the gap in the economic score between firm 2 and 1 (the winning candidate for the cartel)
    - ...firm 1 is able to outbid firm 2 by means of the technical part of the offer

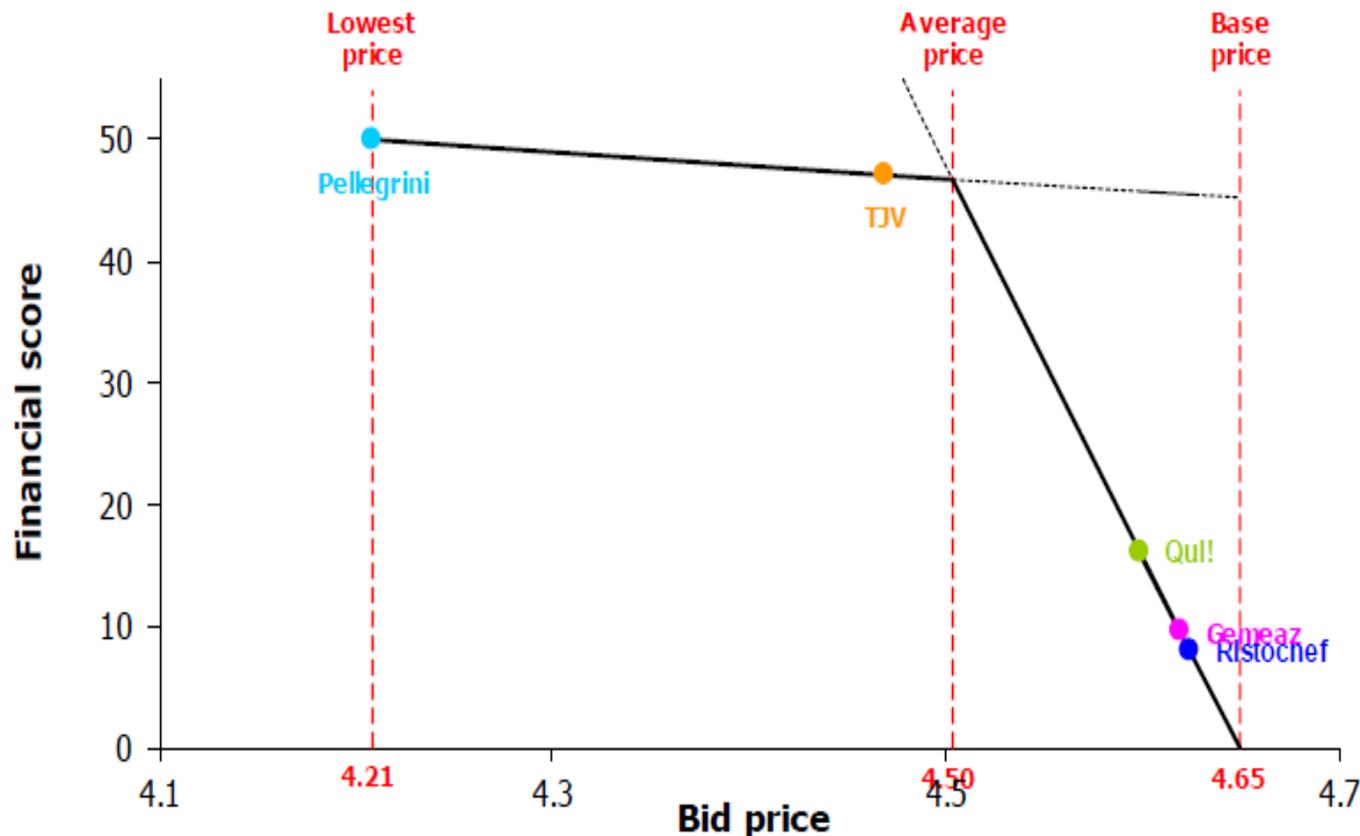
Premium for dmax wrt d2



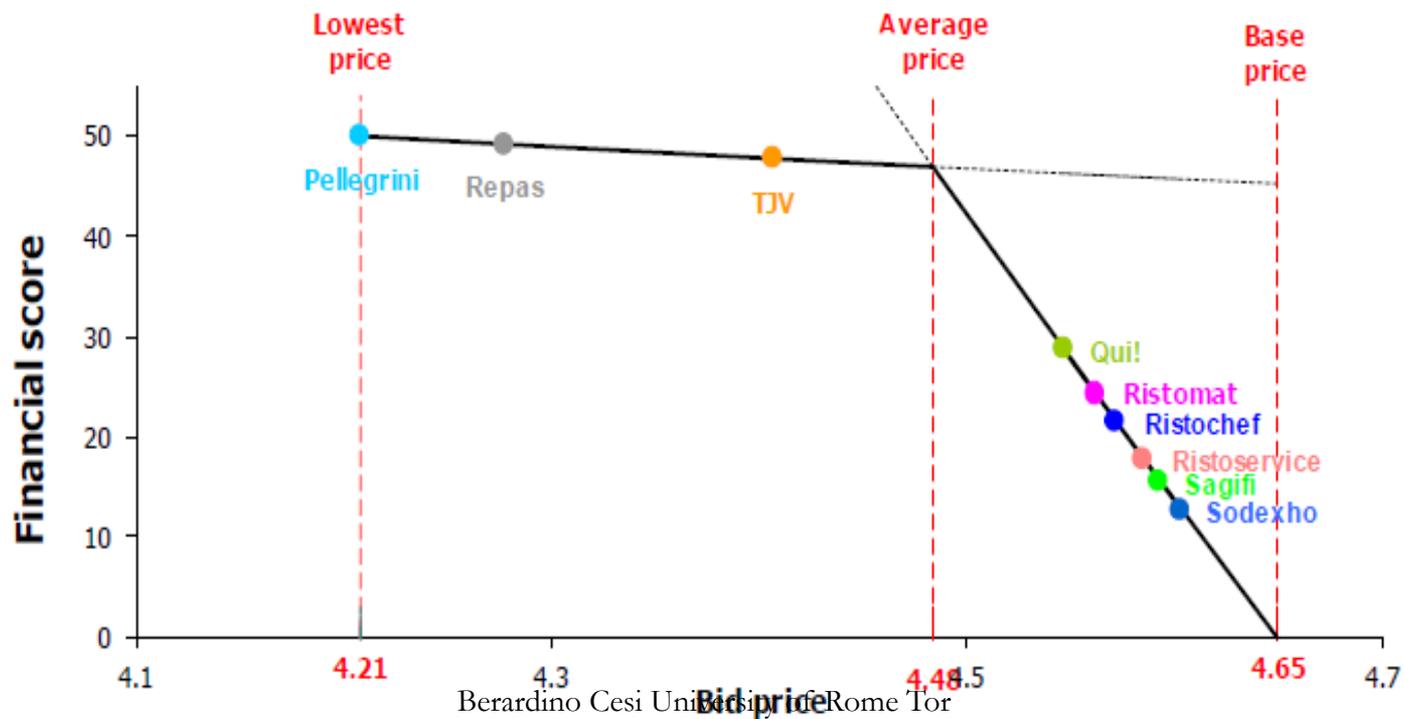
North-West Lot	Financial score	Price (€)	Discount (%)	Technical score	Total score
Pellegrini	50.00	4.21	9.50%	33.81	83.81
TJV (Ristochef, Ristomat, Quil)	48.48	4.34	6.67%	42.69	91.17
Ristoservice	11.32	4.61	0.89%	33.48	44.80
Sodexho	7.10	4.62	0.56%	35.84	42.94
Gemeaz	4.17	4.63	0.33%	49.48	53.65
Average		4.48	3.59%		
Lowest		4.21	0.33%		



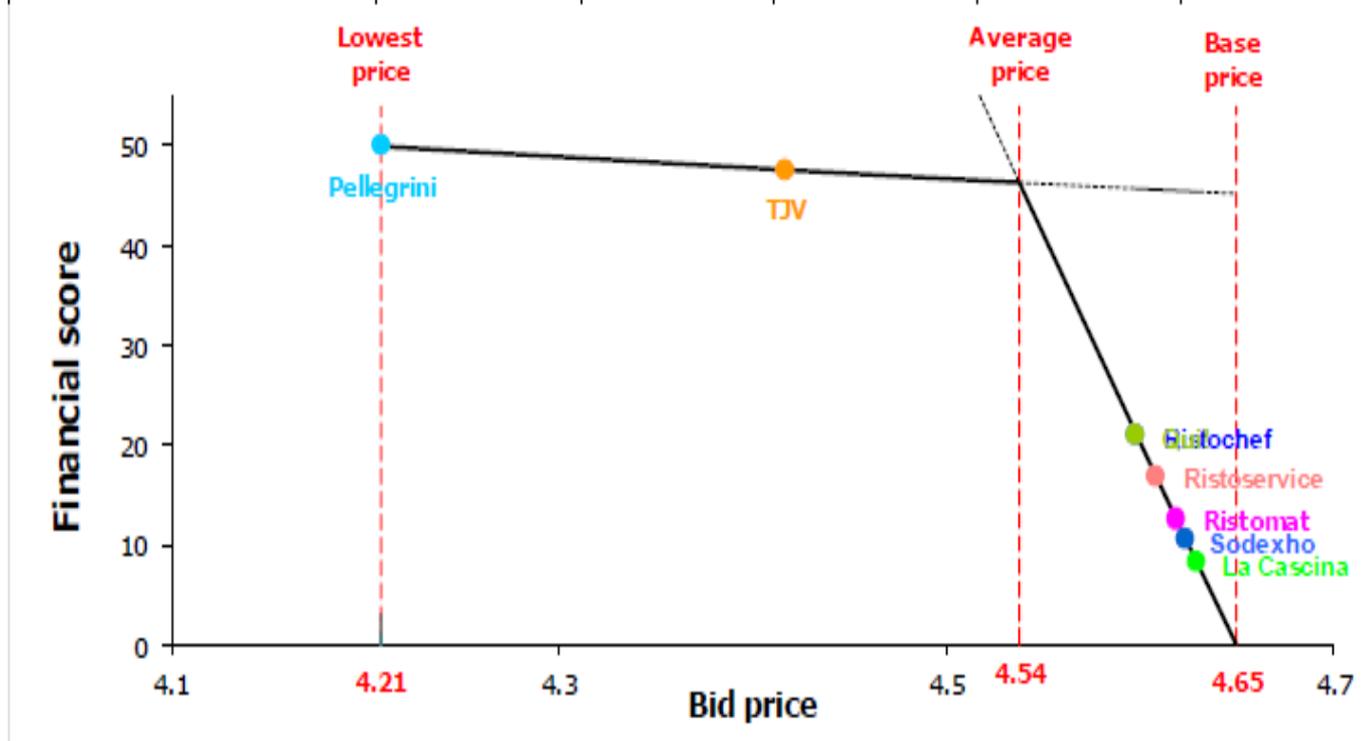
North-East Lot	Financial score	Price (€)	Discount (%)	Technical score	Total score
Pellegrini	50.00	4.21	9.50%	31.94	81.94
TJV (Ristoservice, Ristomat, Sodexho)	47.08	4.47	3.89%	49.22	96.30
Ristochef	8.10	4.62	0.56%	33.68	41.78
Quil	16.14	4.60	1.11%	27.94	44.08
Gemeaz	9.70	4.62	0.67%	44.94	54.64
Average		4.50	3.15%		
Lowest		4.21	0.56%		



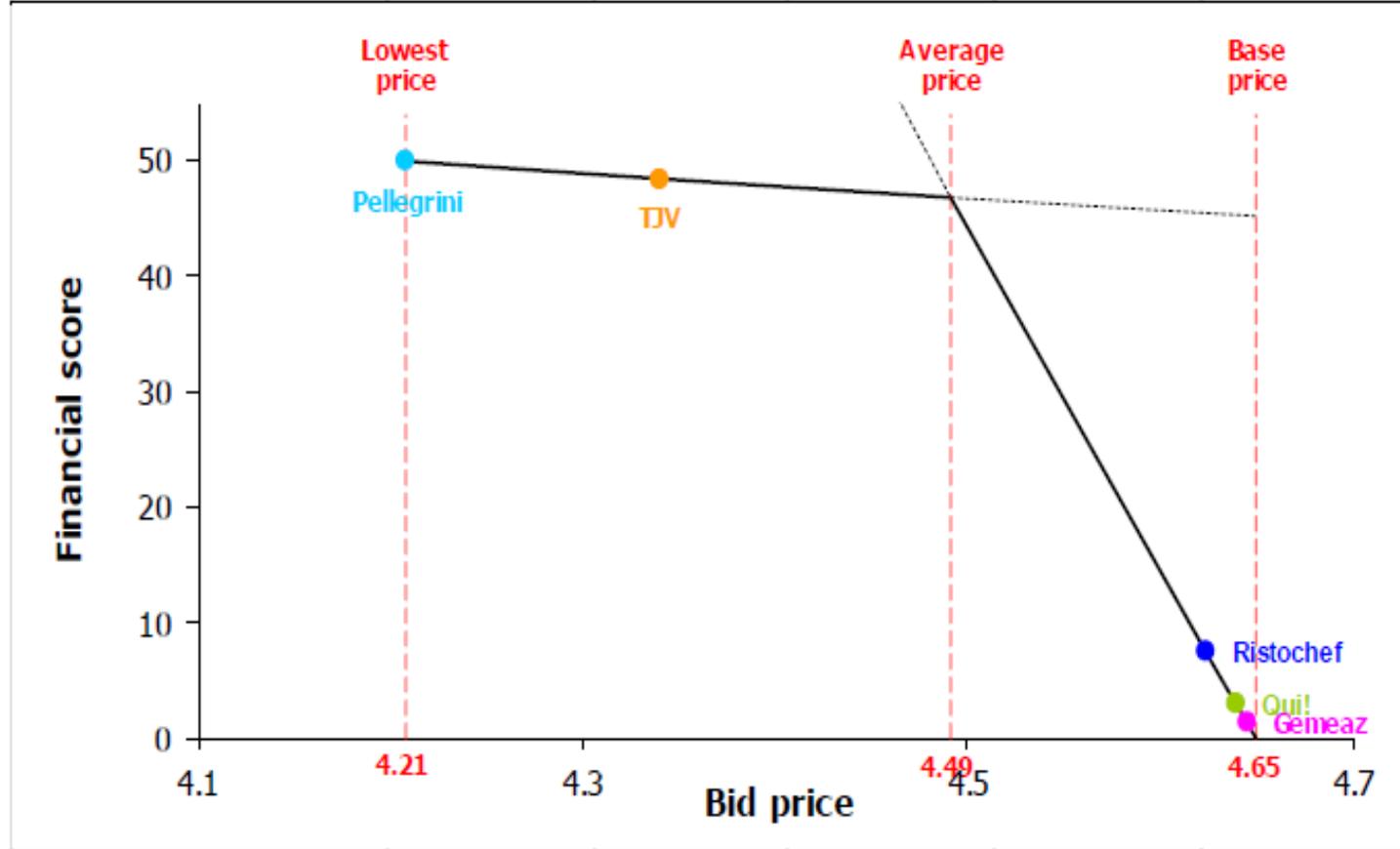
CenterLot	Financial score	Price (€)	Discount (%)	Technical score	Total score
Pellegrini	50.00	4.21	9.50%	25.81	75.81
Repas	49.18	4.28	8.00%	29.28	78.46
TJV (Gemeaz, La Cascina)	47.74	4.41	5.22%	49.48	97.22
Ristoservice	17.88	4.59	1.39%	29.63	47.51
Sodexho	12.81	4.60	1.00%	31.71	44.52
Sagifi	15.66	4.59	1.22%	2.86	18.52
Ristochef	21.54	4.57	1.67%	23.12	44.66
Qui!	28.80	4.55	2.22%	23.15	51.95
Ristomat	24.43	4.56	1.89%	30.17	54.60
Average		4.48	3.57%		
Lowest		4.21	1.00%		



Center-South Lot	Financial score	Price (€)	Discount (%)	Technical score	Total score
Pellegrini	50.00	4.21	9.50%	30.3	80.30
TJV (Gemeaz, Sagifi)	47.63	4.42	5.00%	49.48	97.11
Ristoservice	16.86	4.61	0.89%	33.6	50.46
Sodexho	10.57	4.62	0.56%	33	43.57
La Cascina	8.30	4.63	0.44%	10.86	19.16
Ristochef	21.08	4.60	1.11%	26.88	47.96
Qui!	21.08	4.60	1.11%	31.12	52.20
Ristomat	12.66	4.62	0.67%	30.4	43.06
Average		4.54	2.41%		
Lowest		4.21	0.44%		



<i>South-Islands Lot</i>	Financial score	Price (€)	Discount (%)	Technical score	Total score
Pellegrini	50.00	4.21	9.50%	37.41	87.41
TJV (Ristoservice, Ristomat, Sodexho)	48.48	4.34	6.67%	48.01	96.49
Ristochef	7.47	4.62	0.56%	23.85	31.32
Qui!	2.92	4.64	0.22%	35.28	38.20
Gemeaz	1.46	4.64	0.11%	45.89	47.35
Average		4.49	3.41%		
Lowest		4.21	0.11%		



# Further issues: scoring rule & quality

- Scoring rule & quality
  - Reduce the use of linear scoring rule
  - Parabolic may be better
    - Carefully set “X”.
  - Eliminate the reserve price to mitigate quality undercutting arising from low price-bids
  - Caution with the “mean”-rule
    - Risk of coordination/manipulation
- Scoring rules not always work well with quality
  - Unverifiable quality
    - Dual sourcing