How sellers decide on mechanism: Information matters

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Background

Non-Clairvoyant Environment

- More practical: future distribution is not available in designing mechanism.
- (NC) Non-Clairvoyant Dynamic Mechanism (Mirrokni et al., 2020):
  50% optimal inter-period revenue and 50% optimal intra-period revenue
- (RS) Repeated Static Mechanism (Myerson, 1981):
  0% optimal inter-period revenue and 100% optimal intra-period revenue

NC Cannot Always Outperform RS

- Relative size of inter-period revenue matters.
- Experiments support theoretical revenue predictions (Gui and Houser, 2022).

Research Question

How do Sellers Decide on Mechanism?

- How do Sellers choose between NC and RS?
- Can Sellers make good decision and improve payoff?

What Information Sellers Use in Deciding on Mechanism?

- **Mechanism Features**: NC requires to set more prices.
- **Current Conditions**: NC is optimal for some conditions.
- **Past Experiences**: NC gets less revenue as Buyers might quit the second period.

Experimental Procedure

Settings

- **Clairvoyant environment**: F_1, F_2 known for Sellers at the beginning.
- 10 Rounds + 2 Practice Rounds, feedback on each round, each period.
- Fixed role, re-match for each round.
- Risk task and ambiguity task at last (random ordered) for each session.

Choosing from Two Mechanisms in each Round

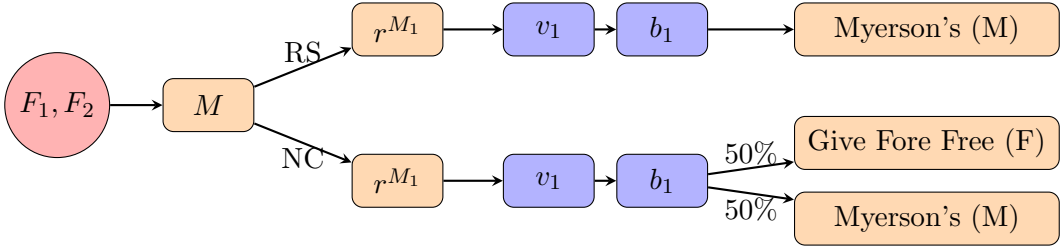
- Non-Clairvoyant Dynamic Mechanism (NC)
- Repeated Static Mechanism (RS)

Experimental Task in each Round

Period 1

1. Seller chooses mechanism, $\mathbf{M}$ (=NC or RS), buyer is informed
2. Seller sets reserve price $\mathbf{r^{M_1}}$ for Period 1, Buyer makes a bid $\mathbf{b_1(v_1)}$.
   - in RS: buyer pays r^{M_1} if $b_1 \geq r^{M_1}$
   - in NC: buyer has 50% chance to get free item

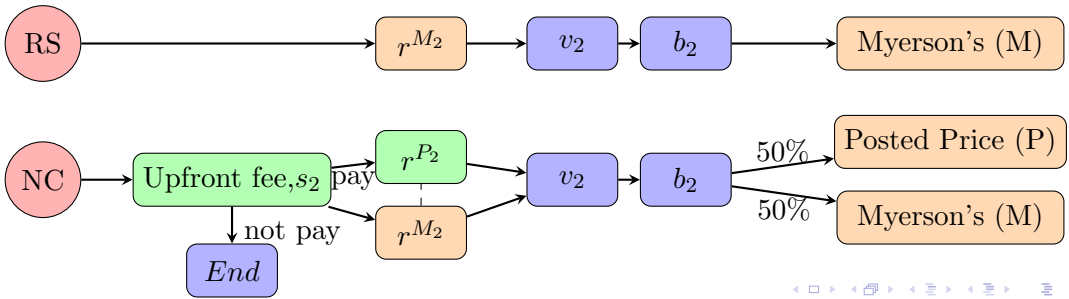
Choose Mechanism for two Periods



Experimental Task in each Round

Period 2

1. Seller sets reserve price r^{M_2} for Period 2
   Full Treatment: s_2, r^{P_2} will be set by Sellers
   Partial Treatment: s_2, r^{P_2} will be set by computer optimally
2. Buyer chooses to pay the upfront fee s_2 or not
   Buyer makes a bid $b_2(v_2)$ in RS or in NC if entering in the market



Experimental Design: Different Information

Mechanism Features - Two Treatments (Between-subject)

- Treatment (Partial): Automated Posted Price Auction (green area)
- Treatment (Full): Sellers set 4 prices in NC and 2 prices in RS.

Current Conditions - Ten Scenarios (3 Groups) (Within-subject)

- 4 Scenarios A: $NC > RS$
- 4 Scenarios B: $NC < RS$
- 4 Scenarios C: $NC = RS$
- For each Session: 2 Scenarios C in Practice Stage + 2 in Tail Stage
  2 Scenarios A + 2 Scenarios B in Early Stage (4 rounds)
  2 Scenarios A + 2 Scenarios B in Later Stage (4 rounds)

Past Experiences - Feedback each Round

Scenarios A ($NC > RS$)

Inter-period revenue is more important

- $\mathbb{E}_2$ is greater than Rev^M in the second period
- $\exists$ "target buyers" (high valuation but low probability) in Period 2

$REV^{RS} = 4,\ REV^{NC} = 4.5\ \uparrow 12.5\%$

$F_A = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{16}), (32, \frac{1}{16})\}, \quad \mathbb{E}_A = 6.$

1. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{2})\}, \quad F_2 = F_A$
2. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{4})\}, \quad F_2 = F_A$
3. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{8})\}, \quad F_2 = F_A$
4. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{16}), (32, \frac{1}{16})\}, \quad F_2 = F_A$

Scenarios B ($NC < RS$)

Intra-period revenue is more important

- $\mathbb{E}_2$ is not great enough while Rev^M can achieve at least half of $\mathbb{E}_2$
- *e.g.*, Constant valuation, $v_2 = 0$ in Period 2.

$REV^{RS} = 4,\ REV^{NC} = 3.5 \downarrow 12.5\%$

$F_B = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{2}), \}, \quad \mathbb{E}_B = 3.$

1. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{2})\}, \quad F_2 = F_B$
2. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{4})\}, \quad F_2 = F_B$
3. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{8})\}, \quad F_2 = F_B$
4. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{16}), (32, \frac{1}{16})\}, \quad F_2 = F_B$

Scenarios C ($NC = RS$)

Inter- is as important as Intra- revenue

- $\iff Rev^P = Rev^{M_1} + Rev^{M_2}$
- *e.g.*, Constant valuation, $v_1 = c_1 = 0$ in Period 1, $v_2 = c_2 \geq 0$ in Period 2.

$REV^{RS} = REV^{NC} = 4$

$F_C = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{4})\}, \quad \mathbb{E}_B = 4.$

1. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{2})\}, \quad F_2 = F_C$
2. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{4})\}, \quad F_2 = F_C$
3. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{8})\}, \quad F_2 = F_C$
4. $F_1 = \{v, p(v)\} = \{(2, \frac{1}{2}), (4, \frac{1}{4}), (8, \frac{1}{8}), (16, \frac{1}{16}), (32, \frac{1}{16})\}, \quad F_2 = F_C$

Summary of Theoretical Revenue (Period 1)

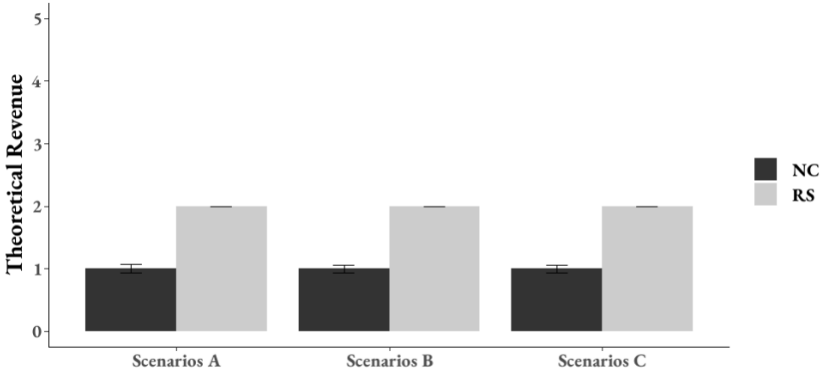


Figure 1: Theoretical Revenue (Period 1)

Summary of Theoretical Revenue (Total)

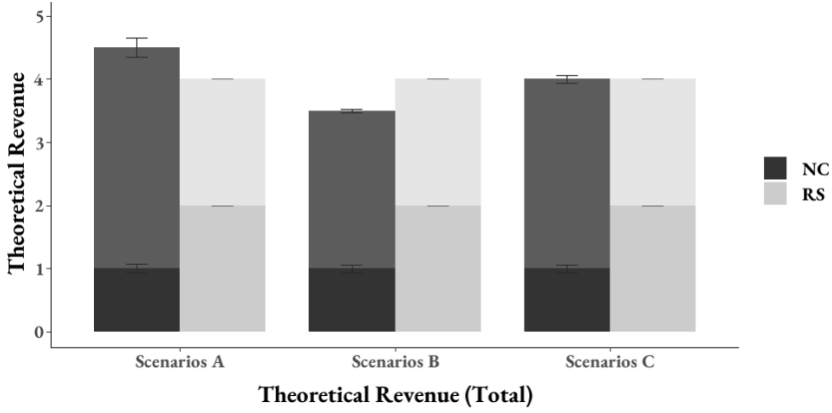


Figure 2: Theoretical Revenue (Total)

Hypotheses

Mechanism Features

- H1: Sellers choose more NC in Partial Treatment.

Current Conditions

- H2: Sellers Choose NC more (less) in Scenarios A (B) in the Later Stage.
- $\Rightarrow$ Sellers choose correct mechanism more in Later stage.

Past Experiences (Revenues)

- H3.1: Sellers get more revenue in NC (RS) in Scenarios A(B).
- H3.2: Sellers choose NC more (less) when past revenue from NC is high (low).

Experiments

- 256 George Mason Students. October to November 2022.

Treatment	**Partial**		**Full**	
Role	**Sellers**	**Buyers**	**Sellers**	**Buyers**
Age	22.6	22.2	21.2	22.5
Gender (Male=1)	0.59	0.62	0.52	0.50
Risk aversion	3.14	3.95	3.90	3.70
Ambiguity	3.30	3.02	3.67	3.32
Observation	64	64	64	64

Table 1: Summary Statistic

Result 1. Mechanism Features Do not Matter

R1. Sellers do not choose NC more in Partial.

- Early Stage: no difference from 50% in either Treatment.
- Later Stage: Significant less than 50% in Partial ($p < 0.01$).
- No treatment difference in either stage.

R1. Sellers do not Choose NC More in Full

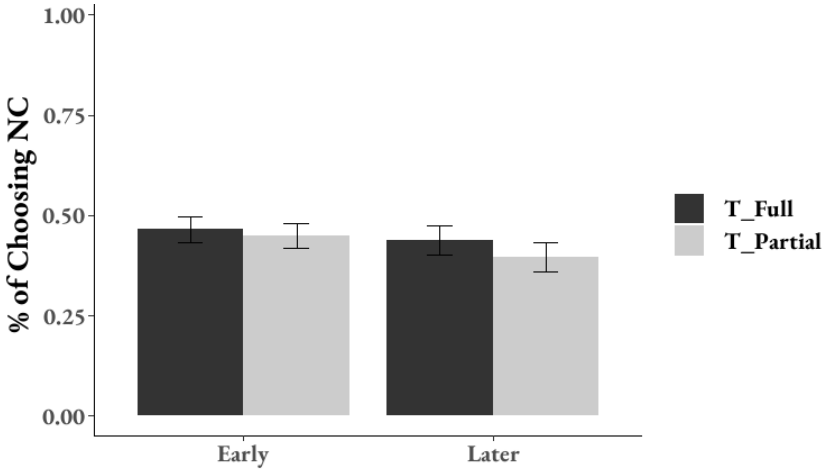


Figure 3: % of Choosing NC

Sellers do not Choose NC More in General

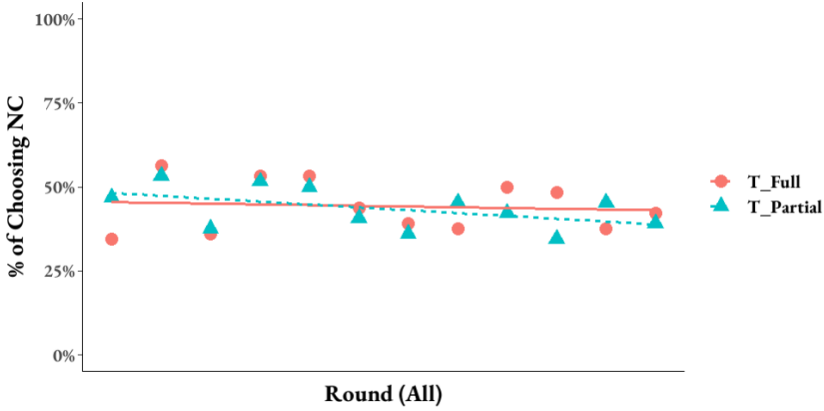


Figure 4: % of Choosing NC

Result 2. Current Conditions Matter

R2. Sellers choose NC less in Scenarios B in Later Stage

- Scenarios A: No difference from 50%
- Scenarios B: Significant less than 50% ($p < .01, p < 0.01$).

$\Rightarrow$ Sellers choose optimal mechanism more in Later Stage

- Early stage: no difference from 50%.
- Later stage: Significant greater from 50% ($p = .01, p < 0.01$).
- No treatment difference in either stage.

R2. Sellers Choose NC Less in Scenarios B

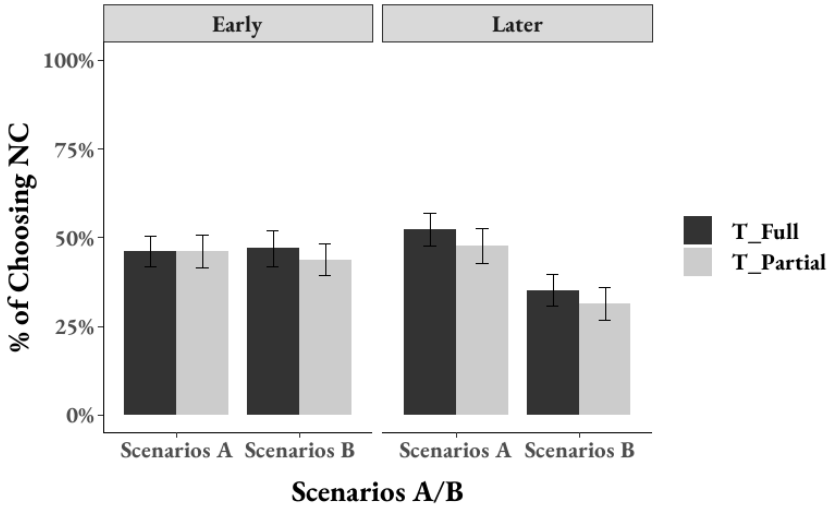


Figure 5: % of Choosing NC by Group of Scenario

Sellers Choose Optimal Mechanism more in Scenarios B

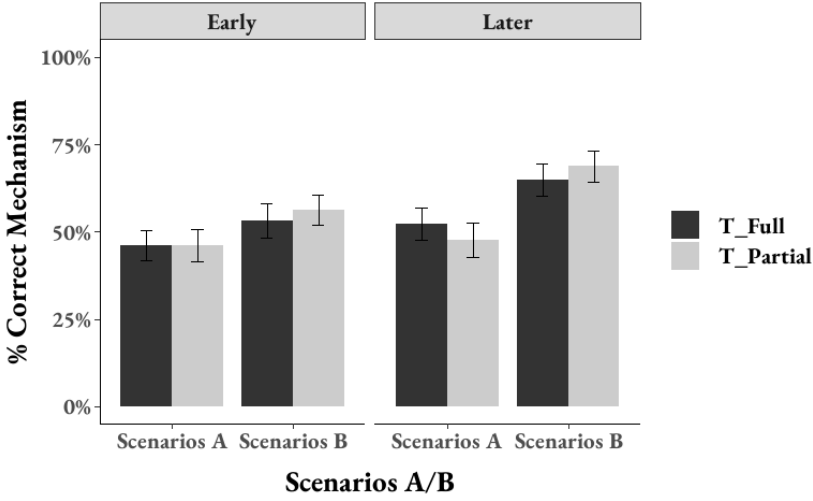


Figure 6: % of Correct Mechanism by Group of Scenario

% of Choosing Correct Mechanism ↑

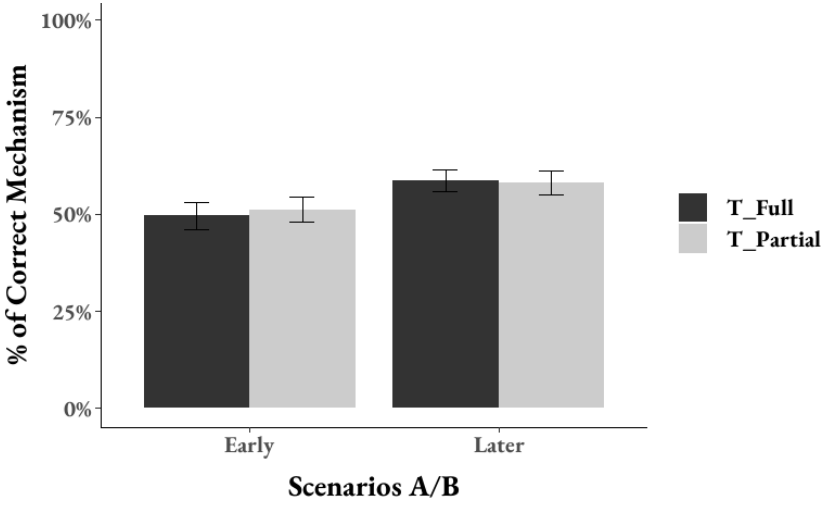


Figure 7: % of Choosing correct Mechanism

% of Choosing Correct Mechanism ↑

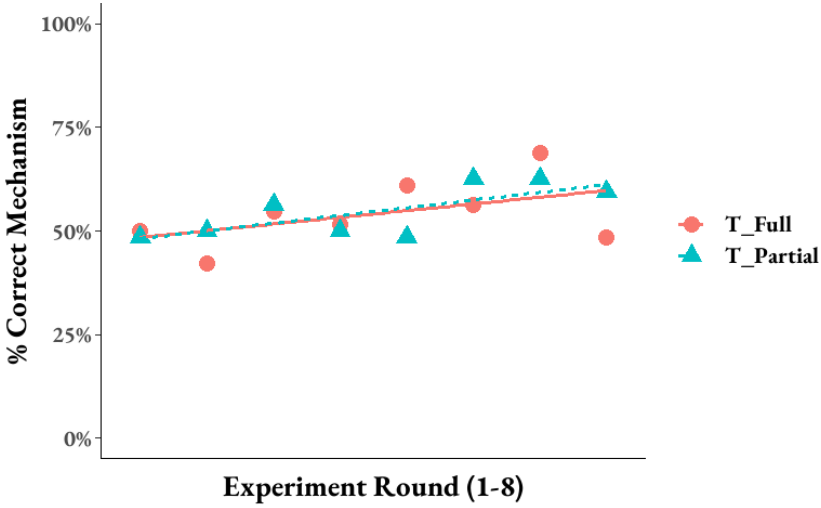


Figure 8: % of Choosing correct Mechanism

Result 3. Past Experiences Matter

R3.1. Sellers get less revenue from NC in Scenarios B.

- In Early stage: no difference from RS
- In Later stage: significantly less than RS ($p < 0.01, p = 0.06$).
- In Scenarios A, Sellers do not get more revenue from NC.

R3.2. Sellers choose NC less if past revenue from NC is low.

- Persist NC more in Later rounds.
- Less likely to choose NC if last round NC got less than 3 points.

Theoretical Revenue by Scenarios in Treatment (Full)

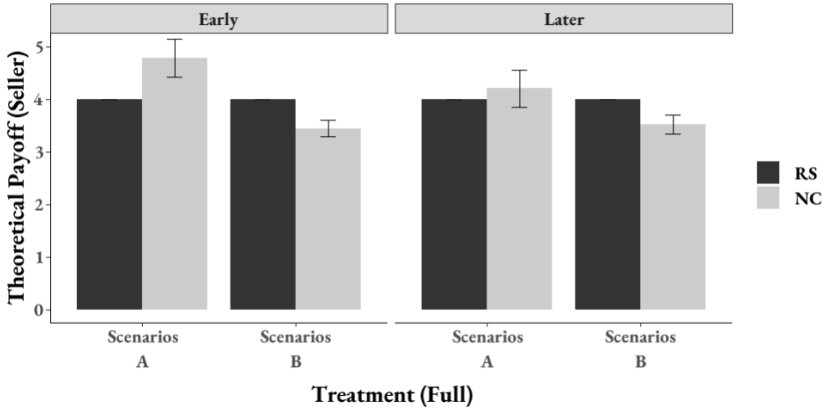


Figure 9: Theoretical Revenue by Scenarios in Treatment (Full)

R3-1. Sellers do not Get More Revenue from NC in Scenarios A (Full)

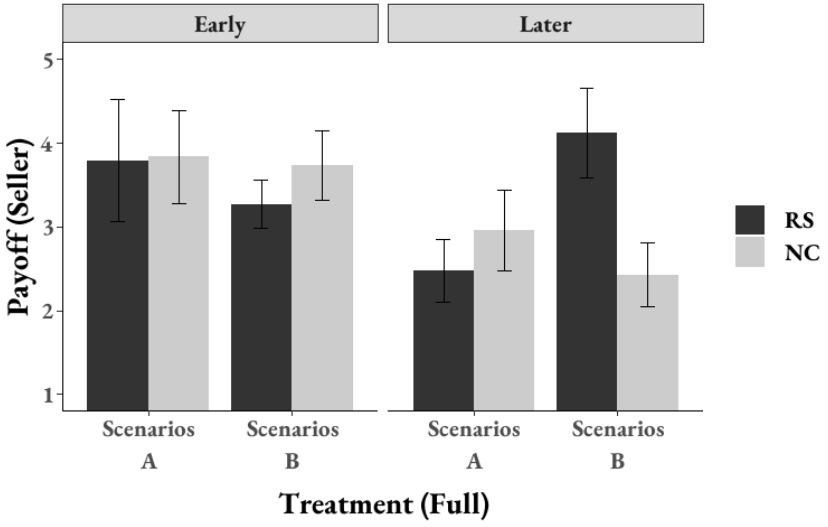


Figure 10: Seller's Payoff by Scenarios in Treatment (Full)

Theoretical Revenue by Scenarios in Treatment (Partial)

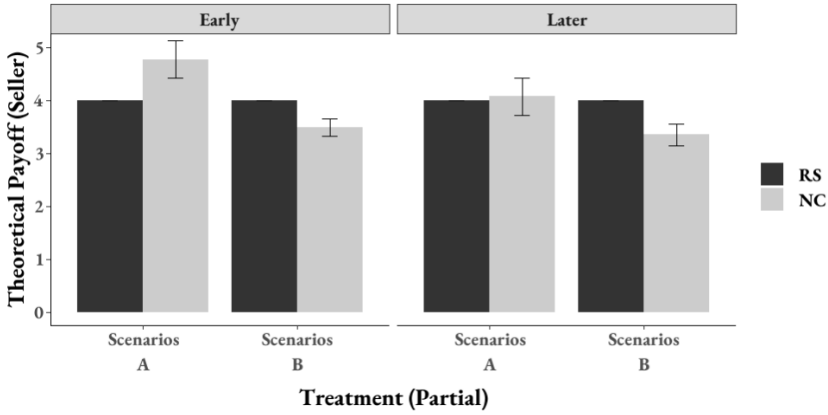


Figure 11: Theoretical Revenue by Scenarios in Treatment (Partial)

R3-2. Sellers Get less Revenue from NC in Scenarios A (Partial)

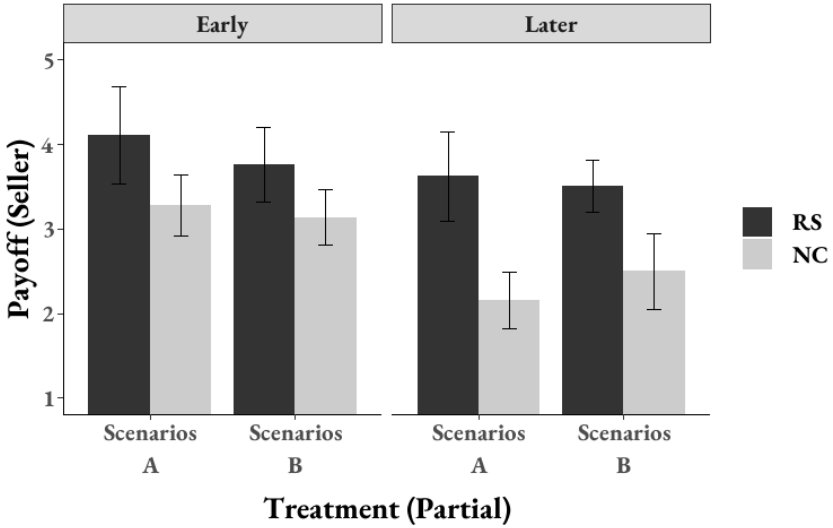


Figure 12: Seller's Payoff by Scenarios in Treatment (Partial)

Why Sellers' Revenues are not improving?

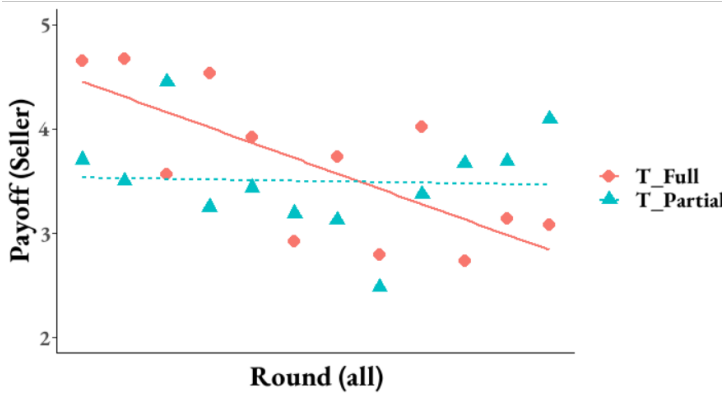


Figure 13: Seller's payoff

Sellers Set higher Prices

In Period 1

- "Go big or go home".
- Aimed high, looking for a heavy bid
- You'd be surprised when I say - I based it off the charts.
- Random.

In Period 2

- Again, attempted high roll, but failed greedily.
- Higher price didn't work so I went lower.
- buyer bid for 1?? which makes no sense so I wanted to get some out of him and set the price to 6 as possible values could have been pretty high. Then set price to 4 as I would get it 50% of the time
- Set a low price, however, buyer decided not to purchase.

Higher Entry Fee in Period 2 in Treatment (Full)

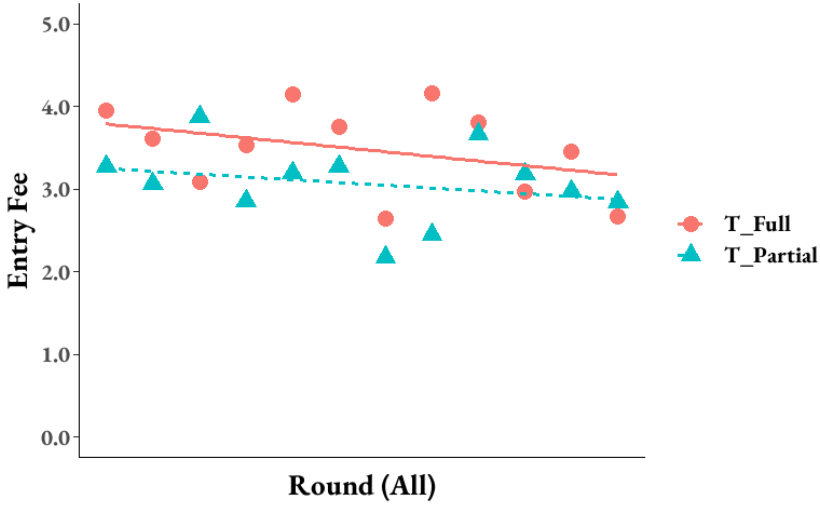


Figure 14: Entry Fee in Period 2

Sellers set entry fee higher than suggested

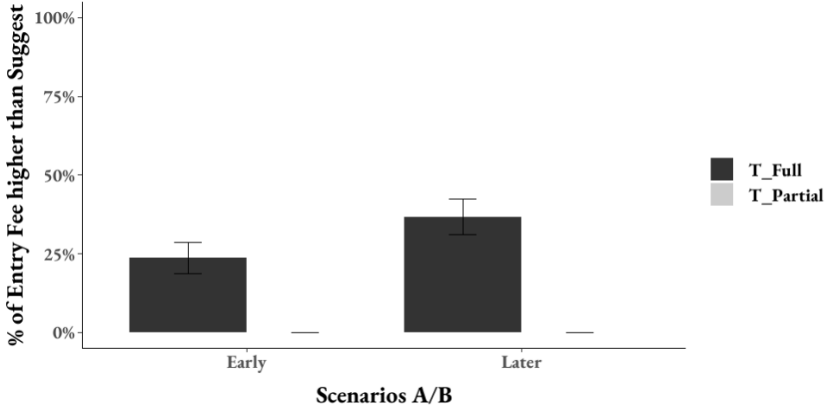


Figure 15: % of Setting Entry Fee Higher than suggested

% of Entering Period 2

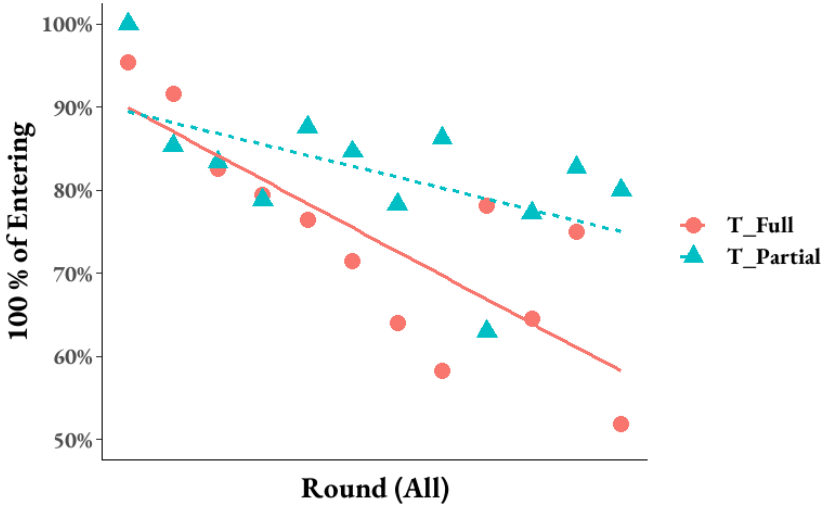


Figure 16: % of Entering Period 2

High Entry Fee Deters Entering

	DV: Enter in Period 2	
	(1)	(2)
T_Partial	0.15	0.28
	(0.16)	(0.17)
Entry Fee	-0.24^{***}	-0.22^{***}
	(0.04)	(0.04)
Later	-0.40^{***}	-0.44^{***}
	(0.11)	(0.12)
Scenarios B	-0.50^{***}	-0.53^{***}
	(0.15)	(0.16)
Constant	1.90^{***}	2.13^{***}
	(0.23)	(0.63)
Controls	No	Yes
Num. obs.	447	447

Table 2: Probit Regression of Enter in Period 2

Bid/Value in Period 1 in Treatment (Full)

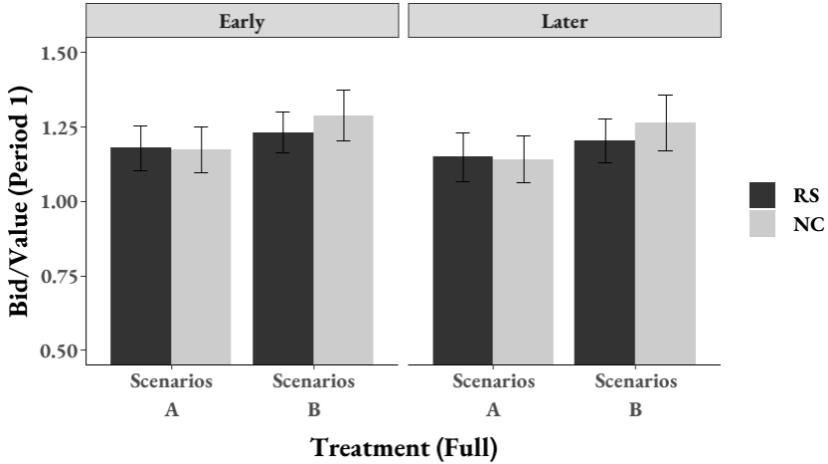


Figure 17: Bid/Value in Period 1 in Treatment (Full)

Bid/Value in Period 2 in Treatment (Full)

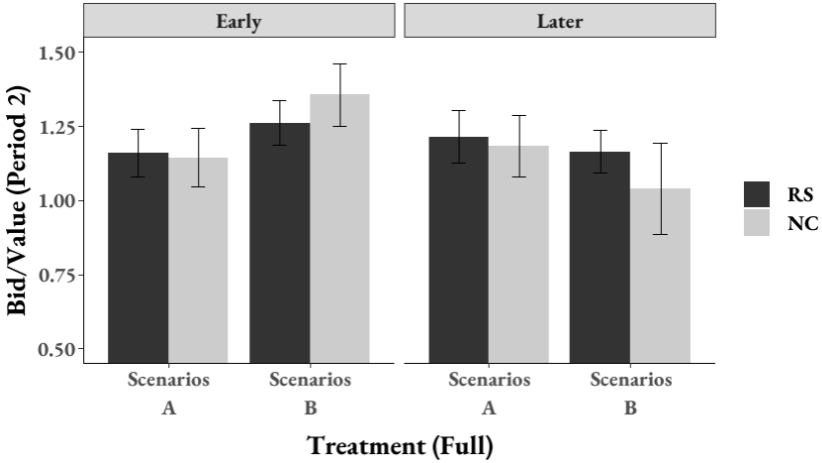


Figure 18: Bid/Value in Period 1 in Treatment (Full)

R3.2: Sellers Choose NC less if NC Had Low Revenue in Last Round

	DV: Choosing NC	
	(1)	(2)
Last (payoff<3, NC)	−0.26***	−0.29**
	(0.08)	(0.12)
Later * Scenarios B	−0.18***	−0.25***
	(0.06)	(0.09)
Later * Treatment(Partial)	−0.03	−0.12
	(0.06)	(0.08)
Later * Last (NC)	0.18*	0.35***
	(0.09)	(0.13)
Later * Last (Correct = NC)	0.01	−0.11
	(0.10)	(0.16)
Later * Last(Enter=1)	0.15	0.25
	(0.13)	(0.19)
Controls	No	Yes
Adj. R^2	0.04	0.06
Num. obs.	1024	1024

Table 3: Regression of Choosing NC

Conclusion

Current Conditions and Past Payoff matters in Choosing Mechanism

- Sellers can find optimal mechanism after gaining experience with the environment.
- Sellers abandon mechanism with low revenue.

Discussion

- Sellers in real life adjust selling strategies as selling condition (or expectation) changes.
- Decision Support Pool: appropriate expectation on Buyers behaviors
- Experts: advice in setting (lower) prices.

Thank you!

How do Sellers make decision?

Sellers set higher entry fee in Full Treatment.

- In Treatment (Full): Entry fee in higher in Early Stage ($p = .03$).
- In Later stage: Entry fee is higher in Treatment (Full) ($p = .04$)
- Compared with RS, seller set high prices in NC.

Higher Entry Fee in Period 2 in Treatment (Full)

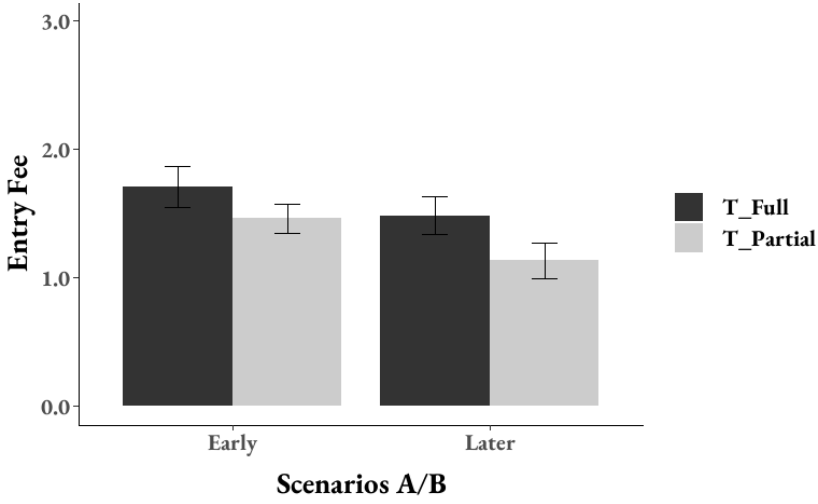


Figure 19: Entry Fee in Period 2

Higher Reserve Price (Myersion) in Period 1 in Treatment (Full)

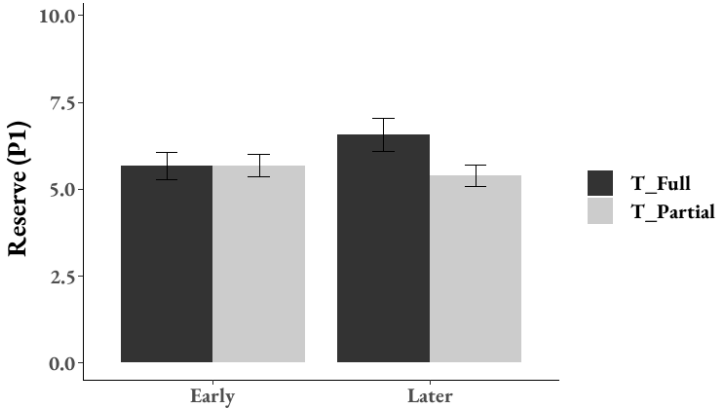


Figure 20: Reserve Price in Period 1

Higher Reserve Price (Myersion) in Period 2 in Treatment (Full)

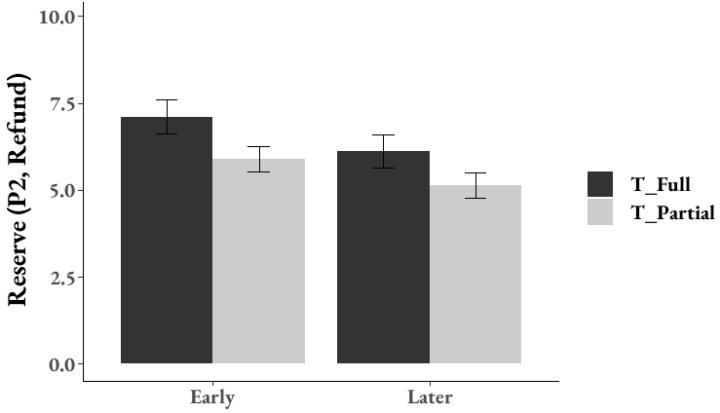


Figure 21: Reserve Price in Period 2 (Refund)

Higher Reserve Price (Posted Price) in Period 2 in Treatment (Full)

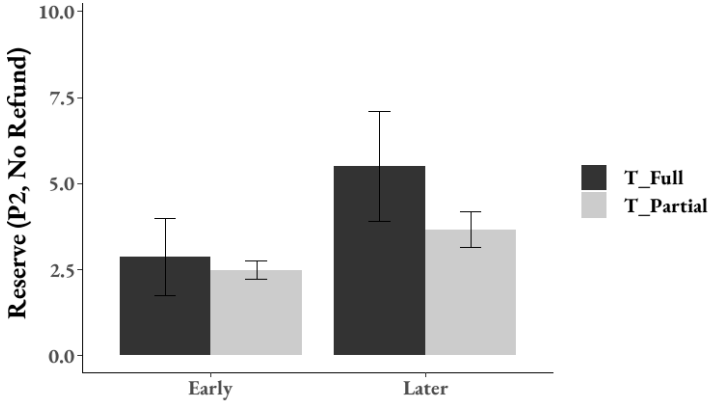


Figure 22: Reserve Price in Period 2 (No Refund)

Seller's Payoff not Increasing

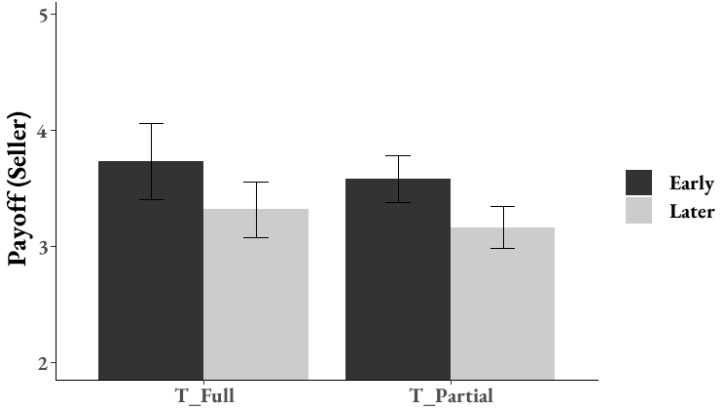


Figure 23: Seller's payoff

Seller's Payoff Inconsistent with Theoretical Prediction

	DV: Seller's Payoff	
	(1)	(2)
Correct	−0.26	−0.16
	(0.32)	(0.30)
T_Partial	−0.17	−0.13
	(0.20)	(0.22)
Later	−0.41*	−0.36*
	(0.22)	(0.21)
Scenarios B	0.06	0.02
	(0.28)	(0.29)
Correct*Scenarios B	0.79**	0.91**
	(0.39)	(0.41)
Value 1	0.29***	0.29***
	(0.05)	(0.04)
Value 2	0.16***	0.17***
	(0.03)	(0.03)
Controls	No	Yes
Adj. R^2	0.23	0.26
N Clusters	128	128

Table 4: Regression of Seller's payoff

How do Buyer make decision?

Buyers quit more in Later stage and in Scenarios B.

- Treatment (Full): significant more quit in Later stage ($p = 0.02$).
- Treatment difference can be explained by high entry fee in Treatment (Full).
- Buyers quit more in Scenarios B.

Buyers do not overbid less in NC.

Bid/Value in Period 1 in Treatment (Partial)

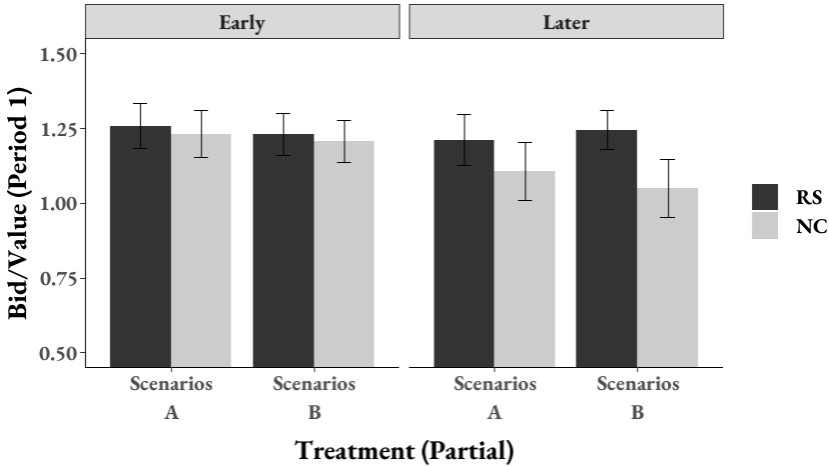


Figure 24: Bid/Value in Period 1 in Treatment (Partial)

Bid/Value in Period 2 in Treatment (Partial)

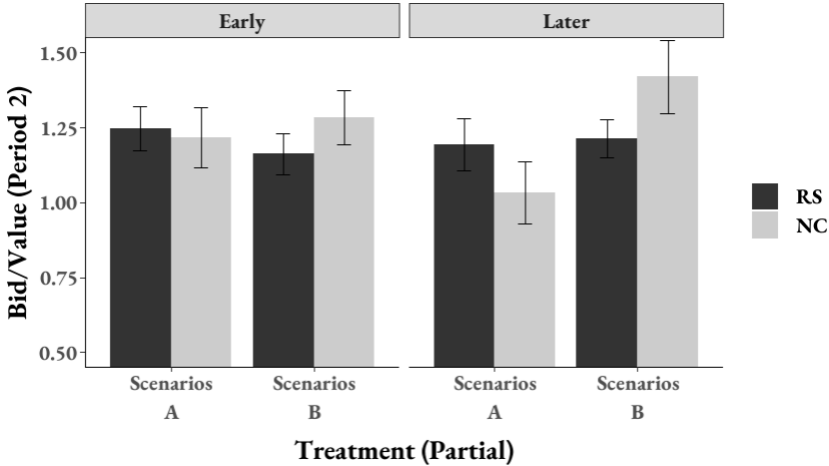


Figure 25: Bid/Value in Period 1 in Treatment (Partial)

Buyer's Payoff

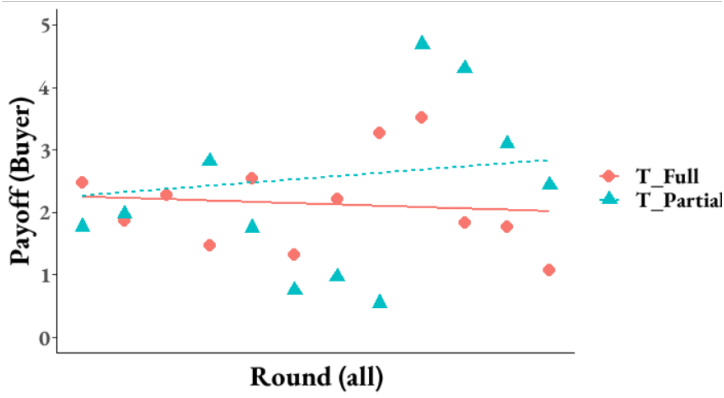


Figure 26: % of Entering Period 2

Learning : Test Summary

Sellers learn the optimal mechanism in Later stage.

- In treatment (Partial): not significant ($p = .06$, one-sided t-test)
  51% correct in Early stage (vs. 0.5, $p = .93$)
  58% correct in Early stage (vs. 0.5, $p < .01$)
- In treatment (Full): significant ($p = .02$, one-sided t-test)
  48% correct in Early stage (vs. 0.5, $p = .72$)
  58% correct in Early stage (vs. 0.5, $p = .01$)
- No difference between treatment ($p = .63$, $p = .46$, one-sided)