

# Abatement Investment Decisions under Alternative Emissions Regulation:

## Preliminary Findings from an Economic Experiment

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This research has been financially supported by Linkage Grant LP 100200252  
“Emissions trading and the design and operation of Australia’s energy  
markets” from the Australian Research Council, in partnership with the  
Australian Financial Markets Association.



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SYDNEY

- Market performance
- Motivation of efficient investment
- Compare efficiencies
  - Investment costs
  - Total abatement costs
  - Overall

## Guiding question:

How will investments and production under a **transition-hybrid** differ from

- a **tax**?
- an **ETS**?

# Hypothesis

- Tax: most optimal behaviour
- ETS: least optimal behaviour
- Transition-Hybrid: more optimal than ETS, less optimal than tax

→	Tax	
→	Tax	ETS
→	ETS	

# Experiment Design

- 3 Treatments
- 9 Sessions
- University of Sydney students, recruited by ORSEE (Greiner, 2004)
- Programmed in zTree (Fischbacher, 2007)

# Treatments

	Phase 1	Liability Phase	
Tax	Pre-Liability	Tax	
ETS	Pre-Liability	ETS	
Transition Hybrid	Pre-Liability	Tax	ETS

- 8 Decision Makers per Group
- Each Round = 13 Periods
- 4 Rounds per Session

**Balance: \$ 0.00**

**Held Inputs: 0.0**

**Required Inputs: 0.0**

**Input Price: \$ 0.00**

**Expenses Due: \$0.00**

	Production Level	Production Income (\$)	Required Inputs
Select Level 0	0	\$0.00	0.0
Select Level 1	1	\$7.50	1.0
Select Level 2	2	\$15.00	2.0
Select Level 3	3	\$22.50	3.0
Select Level 4	4	\$30.00	4.0
Select Level 5	5	\$37.50	5.0
Select Level 6	6	\$45.00	6.0
Select Level 7	7	\$52.50	7.0
Select Level 8	8	\$60.00	8.0
Select Level 9	9	\$67.50	9.0
Select Level 10	10	\$75.00	10.0

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Select Level 8	8	\$60.00	8.0
Select Level 9	9	\$67.50	9.0
Select Level 10	10	\$75.00	10.0



Period: 2 of 13

Time Remaining: 58

Balance: \$ 0.00

Continue

My Total Percent Reduction of Required Inputs: 0%

Production Level	Production Income (\$)	Required Inputs
0	\$0.00	0.0
1	\$7.50	1.0
2	\$15.00	2.0
3	\$22.50	3.0
4	\$30.00	4.0
5	\$37.50	5.0
6	\$45.00	6.0
7	\$52.50	7.0
8	\$60.00	8.0
9	\$67.50	9.0
10	\$75.00	10.0

Investment Cost	Reduction of Required Inputs	Status
\$12.50	10%	Invest 1
\$62.50	10%	
\$112.50	10%	
\$162.50	10%	



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# Results:

## Efficiency Comparisons

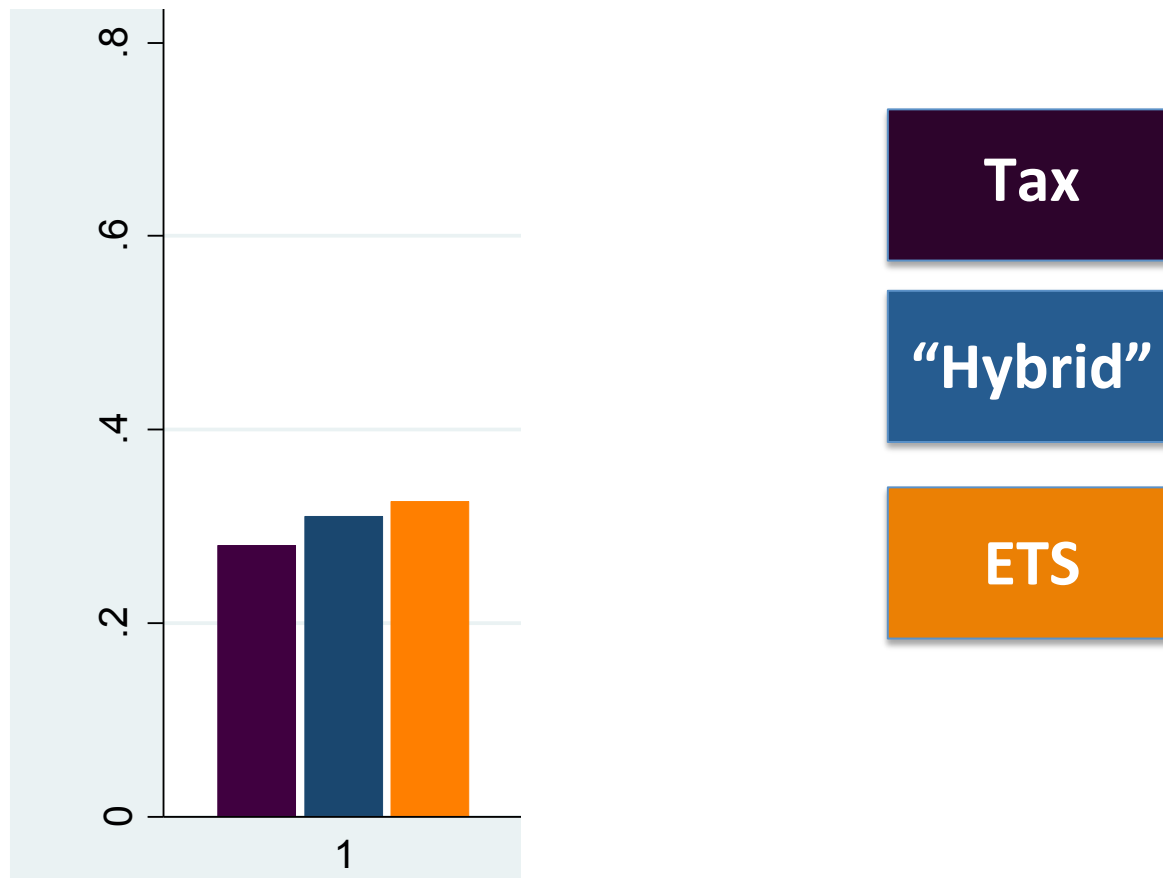
- Investment Cost
- Total Abatement
- Overall Earnings

# Investment Cost Efficiency

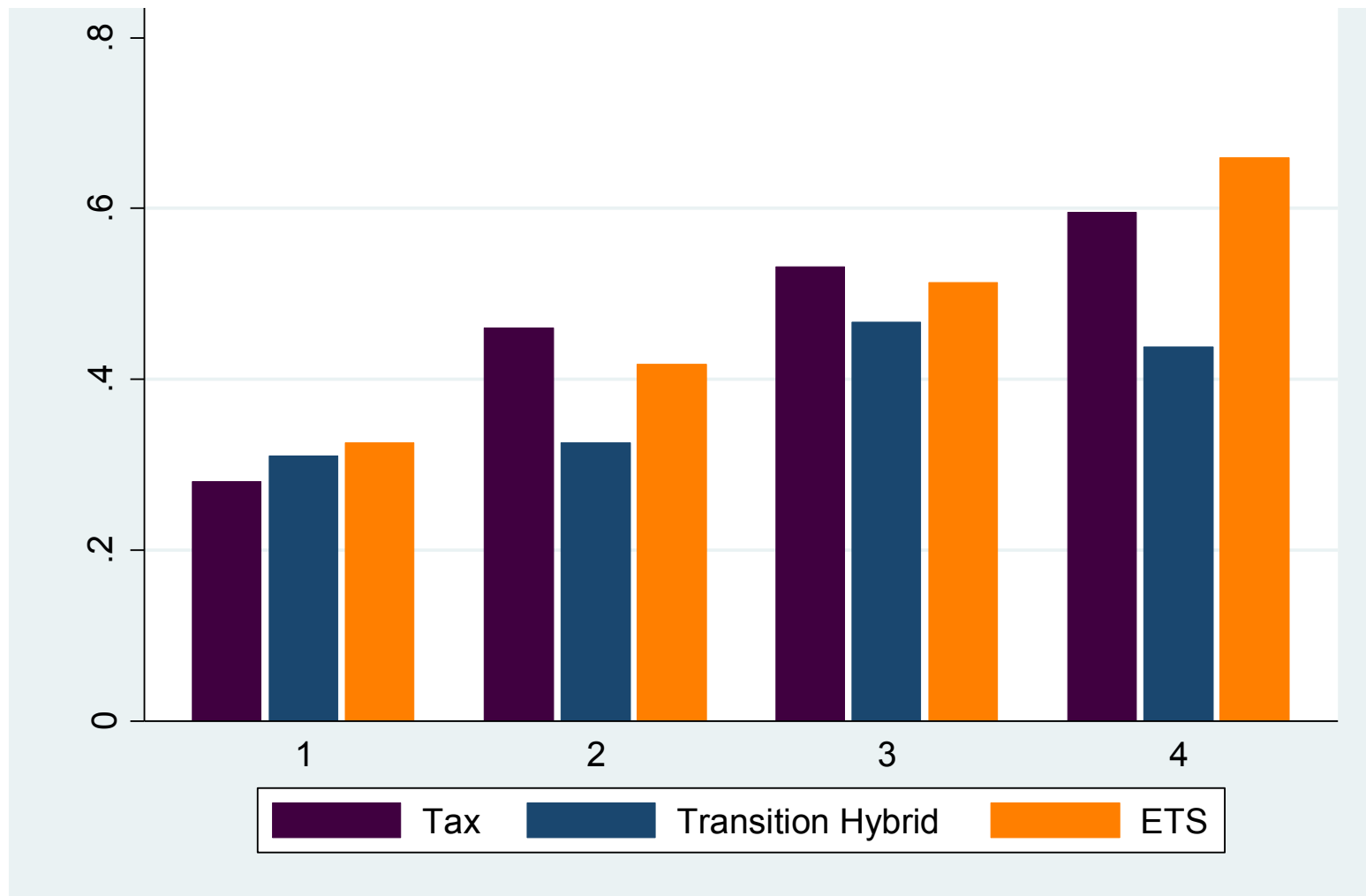
$$= \frac{\textit{Minimum Investment Costs}}{\textit{Actual Investment Costs}}$$

$$\frac{\min. \sum_{i=1}^n IC(U_i)}{\sum_{i=1}^n IC(U_i)}$$

# Investment Cost Efficiency



# Investment Cost Efficiency



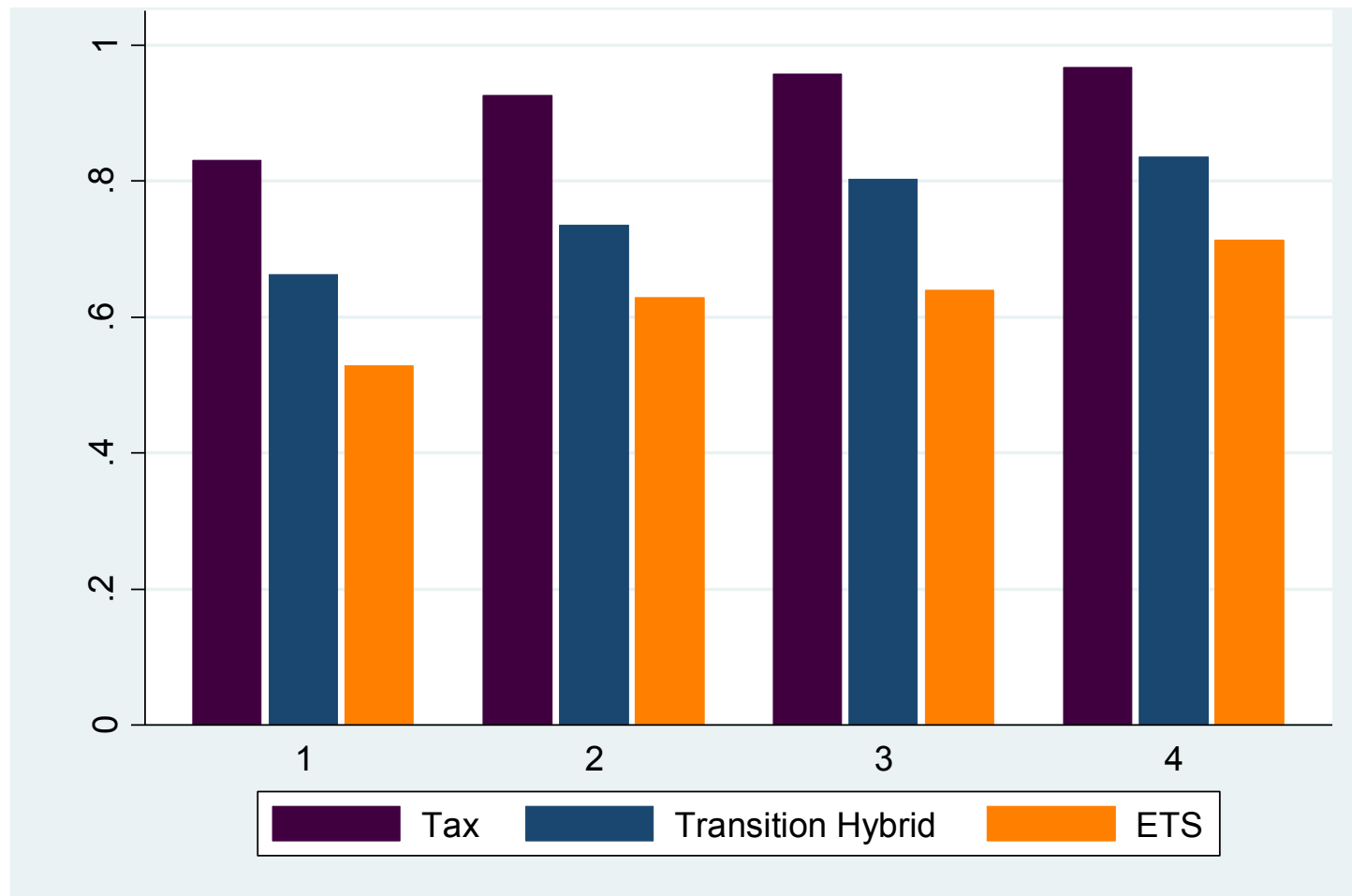
# Abatement Cost Efficiency

Production income, given investment

$$= \frac{\textit{MinimumTotalAbatementCosts}}{\textit{ActualAbatementCosts}}$$

$$\frac{\min. \sum_{i=1}^n IC^*(U_i^*) + (Y_0^* - Y_R^*) + Tax^*}{\sum_{i=1}^n IC(U_i) + (Y_0 - Y_R) + Tax}$$

# Abatement Cost Efficiency

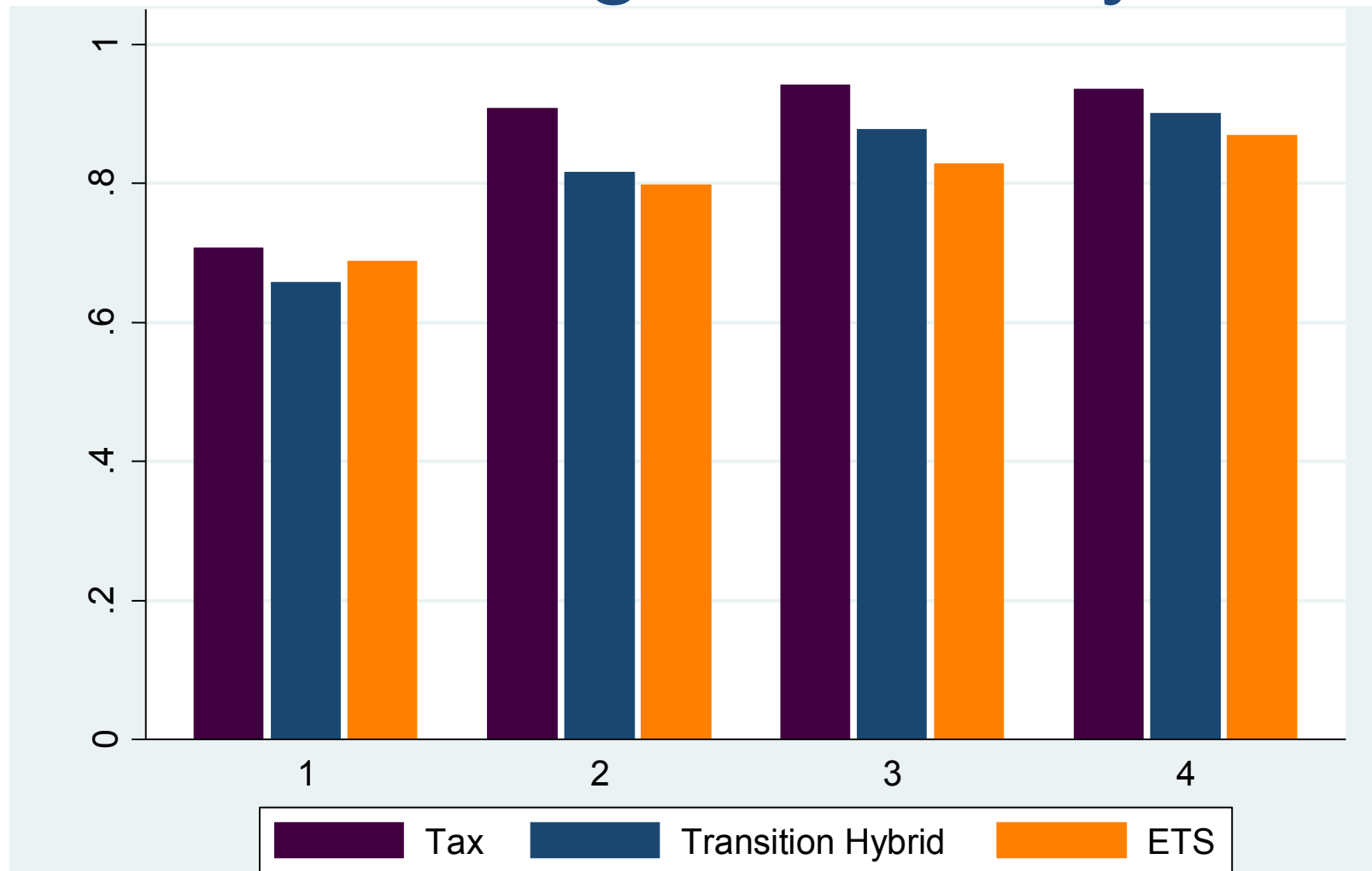




# Earnings Efficiency

$$= \frac{\textit{Actual Earnings}}{\textit{Maximum Earnings}}$$

# Earnings Efficiency



# Conclusions

## Based on our Assumptions

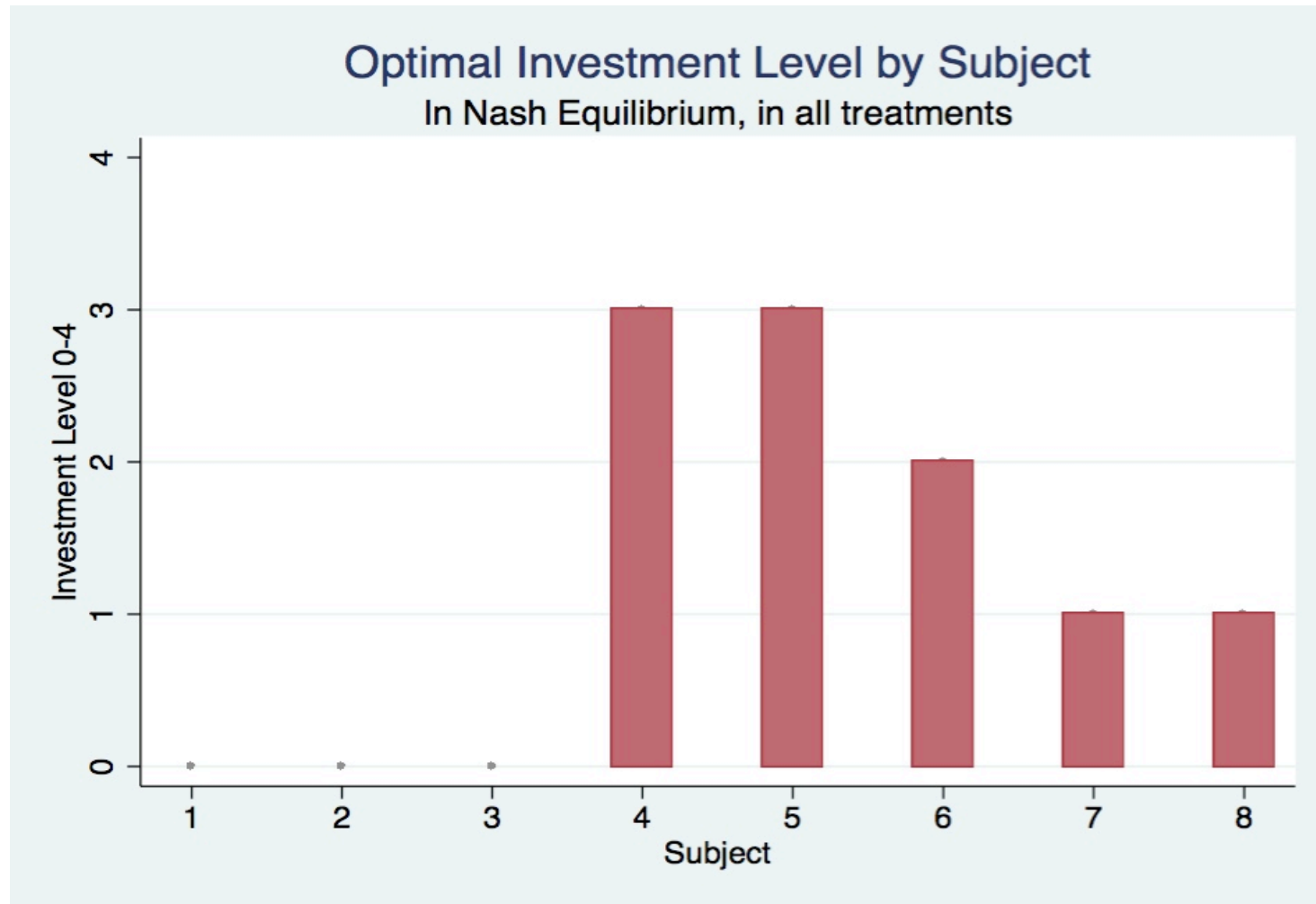
- Investment Costs
  - Hybrid is the least efficient (not significant)
- Total Abatement Cost
  - Hybrid is more efficient than ETS, less than tax\*\*
- Earnings
  - Hybrid is more efficient than ETS, less than tax\*\*

# Future Plans

- Additional Observations
- Additional Treatments
  - Introduce policy uncertainty
  - Price ceilings and price floors
  - Suboptimal tax rate

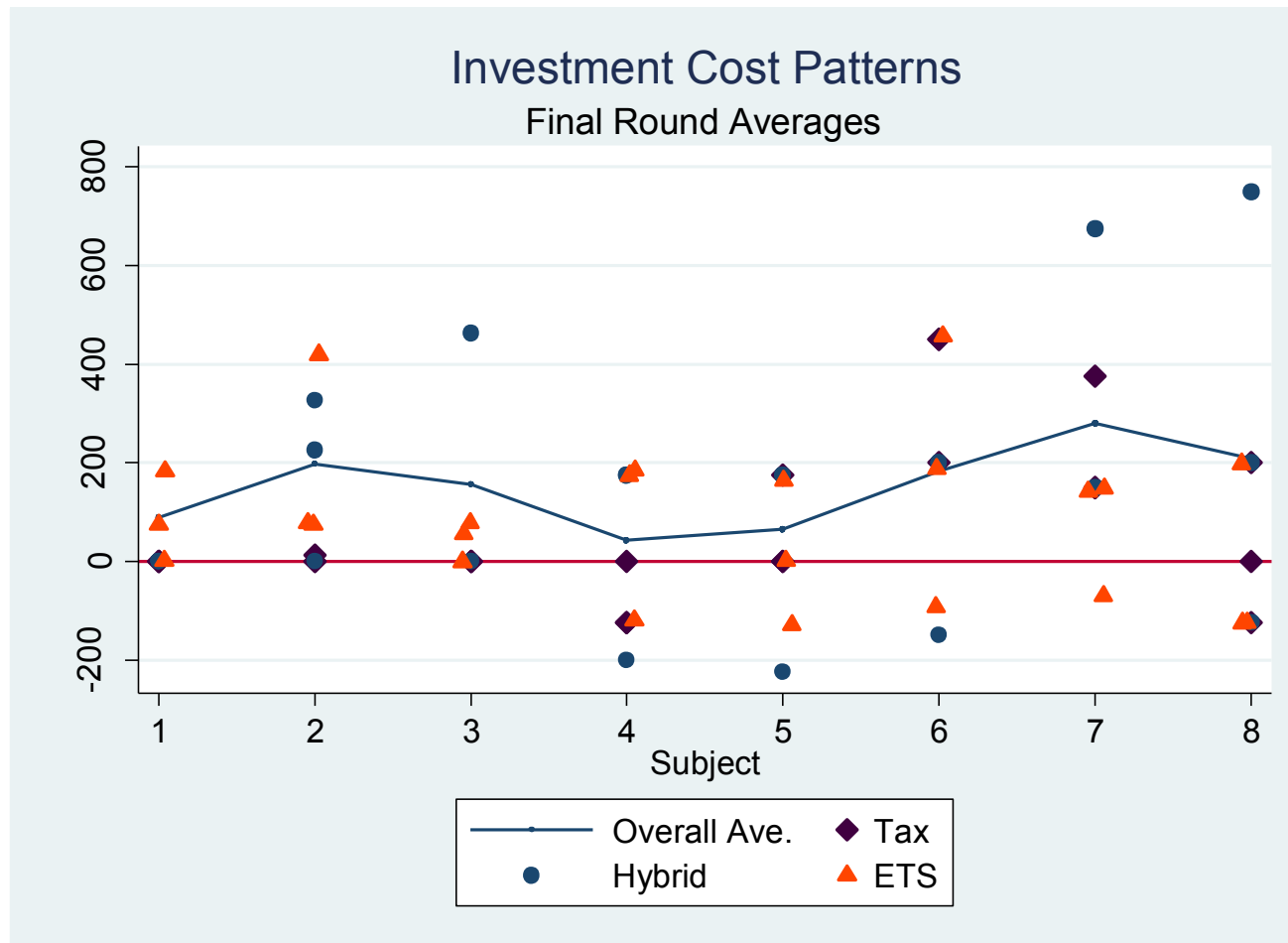
# Thank you!

# Investment



# Investment Costs

By Subject Type



	<b>Round 1</b>	<b>Round 2</b>	<b>Round 3</b>	<b>Round 4</b>
	0.25	0.27	0.38	0.50
<b>Tax</b>	0.34	0.67	0.57	0.52
	0.25	0.44	0.65	0.77
	0.29	0.40	0.61	1.03
<b>ETS</b>	0.28	0.40	0.42	0.35
	0.40	0.46	0.51	0.59
	0.29	0.29	0.40	0.52
<b>Transitional Hybrid</b>	0.25	0.32	0.37	0.32
	0.39	0.37	0.63	0.47