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Coordination and allocation on land markets under increasing scale economies and heterogeneous actors – an experimental study

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Introduction

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- Economies of scale often not exploited in Western agriculture
  - dominance and persistence of small family farms (Balmann 1994, 1995)
- „Too little“ participation in collaborative arrangements that allow small firms to exploit economies of size
- Possible explanations for unexploited increasing returns
  - transaction costs limit
  - coordination failures among heterogeneous actors

Introduction

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- This study focuses on the last explanation, i.e. coordination failures among heterogeneous actors
  - Balmann (1994,1995)
    - establishing large arable farms in small farm agriculture can require price differentiation on land market
  - Aurbacher, Lippert, Dabbert (2007)
    - establishing machinery cooperations can require price differentiation

Objective

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- Research question
  - Can price differentiation be achieved among heterogeneous actors?
- Approach
  - Case study: land market problem of Balmann (1995)
  - Laboratory experiments with students
  - An agent-based model with computationally intelligent agents using genetic algorithms provides a normative benchmark prediction

Outline

- Description of the land market example
- Experimental setting
- Benchmark prediction
- Experiment results
- Conclusions and further research

A land market example

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Imagine the following situation

- A profit maximizing entrepreneur characterized by increasing returns wants to „take over“ a certain number of neighboring small farms
- The small farmers are assumed to
  - be equally large in terms of land
  - have land with identical physical properties
  - have heterogeneous reservation prices (opportunity costs) for their land
  - have private information on their reservation prices (but know the distribution of the others´ reservation prices.

A land market example

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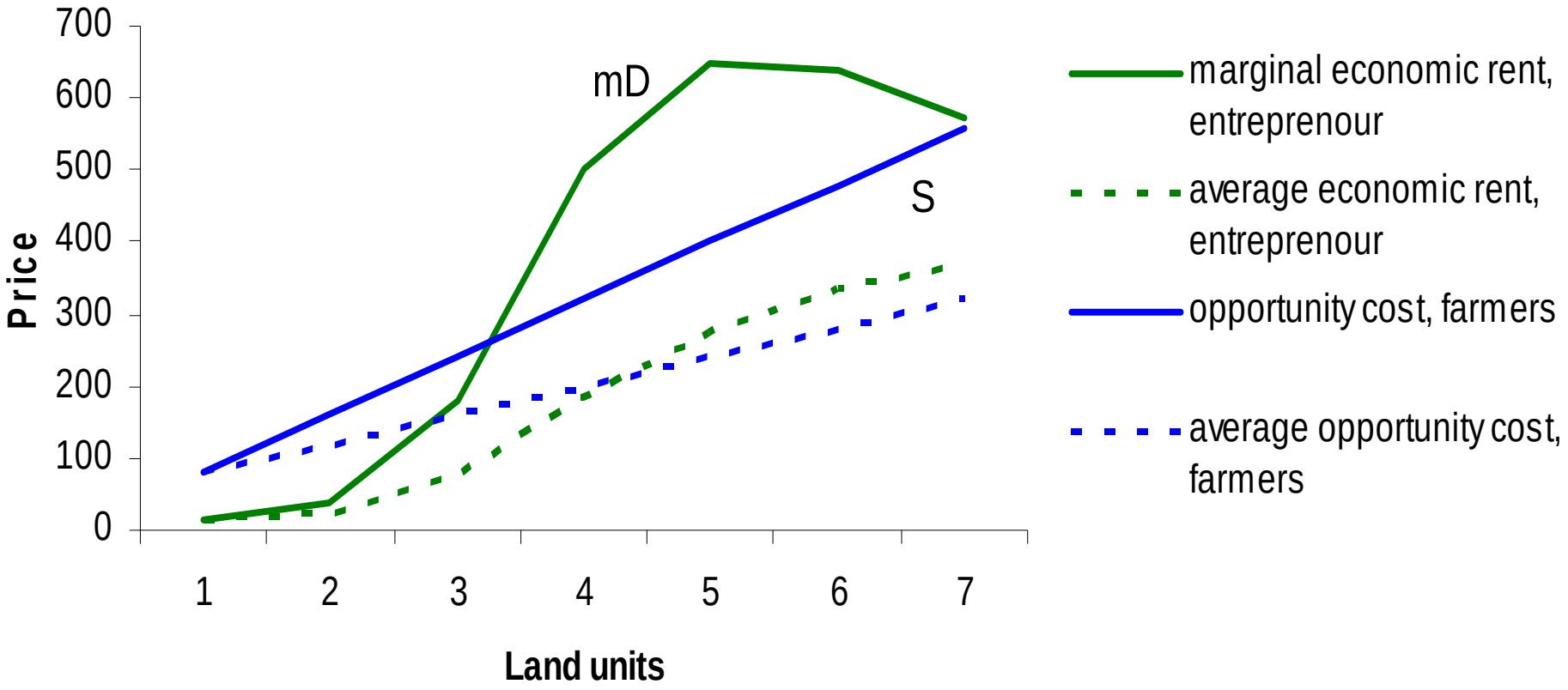

A land market example

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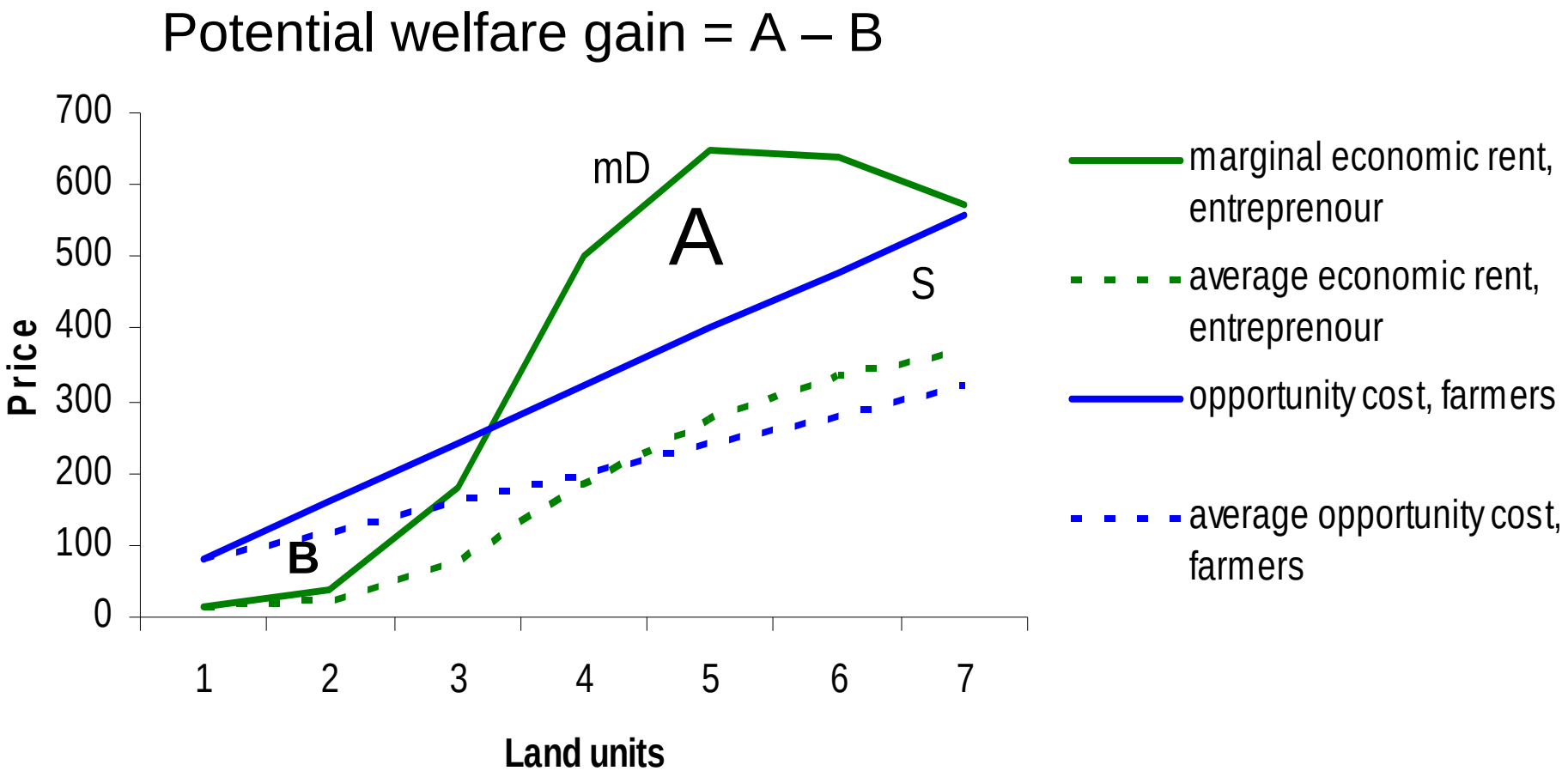

Experimental setting

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- Four scenarios (treatments):
  - two different levels of potential welfare gain: „tight“ and „generous“ room for negotiation.
  - two group sizes: „small“ (7 players) and „large“ (14 players)

		Group size	
		“Small” (7 players)	“Large” (14 players)
Potential welfare gain	“Tight” (A-B=352)	*Treatment 1*	*Treatment 3*
	“Generous” (A-B=704)	*Treatment 2*	*Treatment 4*

Experimental setting

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Example of parameters (treatment 1: 7 players, tight room for negotiations)**

		Assumptions				
		Players		Entrepreneur		
Player	Sum of land units	Opportunity cost of land unit*	Average opportunity cost	Total value of production*	Marginal value of production	Average value of production*
1	1	80	80	12	12	12
2	2	160	120	52	40	26
3	3	240	160	232	180	77.3
4	4	320	200	732	500	183
5	5	400	240	1382	650	276.4
6	6	480	280	2022	640	337
7	7	560	320	2592	570	370.3

* Information presented to the players

** Total potential welfare gain
= Total value of production (at 7 players) - sum of players opportunity costs
= 2592 – 2240 = 352

Experimental setting

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- 40 repetitions/rounds
- Entrepreneur is computerized and profit-maximising
- Opportunity costs randomly assigned to the participants in each round
- Each player has information about
  - His/her own opportunity costs
  - The distribution of the other players‘ opportunity costs
  - The entrepreneur‘s production function (and average production)
  - ➢ Players are well informed!

Experimental setting

- In each round, every player makes a bid (an ask)
- After every round, each player receives feedback on
  - the number of transactions occured
  - acceptance or decline of the players own ask
  - the own payoff in the round
- The players are not informed about the other players‘ asks and payoffs

Experimental setting

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- The subject pool consisted of 98 participants (28 in treatments 2, 3 and 4; 14 in treatment 1)
- Monetary incentives were given that are proportional to the players performance in the game

What should we expect?

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- Benchmark case
  - game theoretic equilibrium for bidding behavior
  - agent-based simulation with genetic algorithm learning
- In the ABM, the entrepreneur and small farmers are modeled as agents
  - entrepreneur and small farmers interact repeatedly on market
  - small farmers “learn” optimal individual bids for given opportunity costs by applying individually a genetic algorithm (GA) (Dawid, 1999)
  - the model converges towards a game theoretic equilibrium

Benchmark case – simulations with agent-based model

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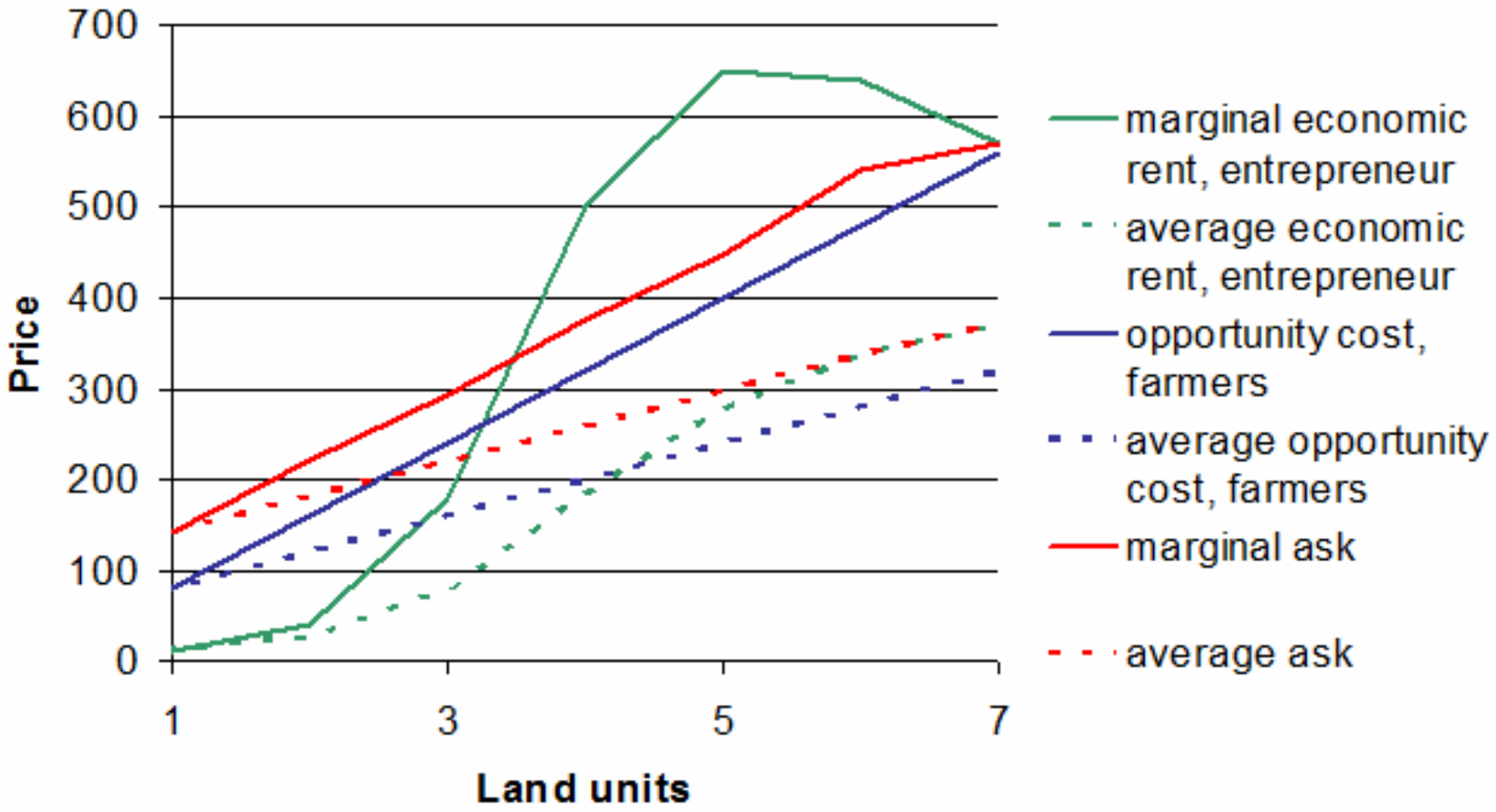
Outcome of GA: treatment 1



Benchmark case – simulations with agent-based model

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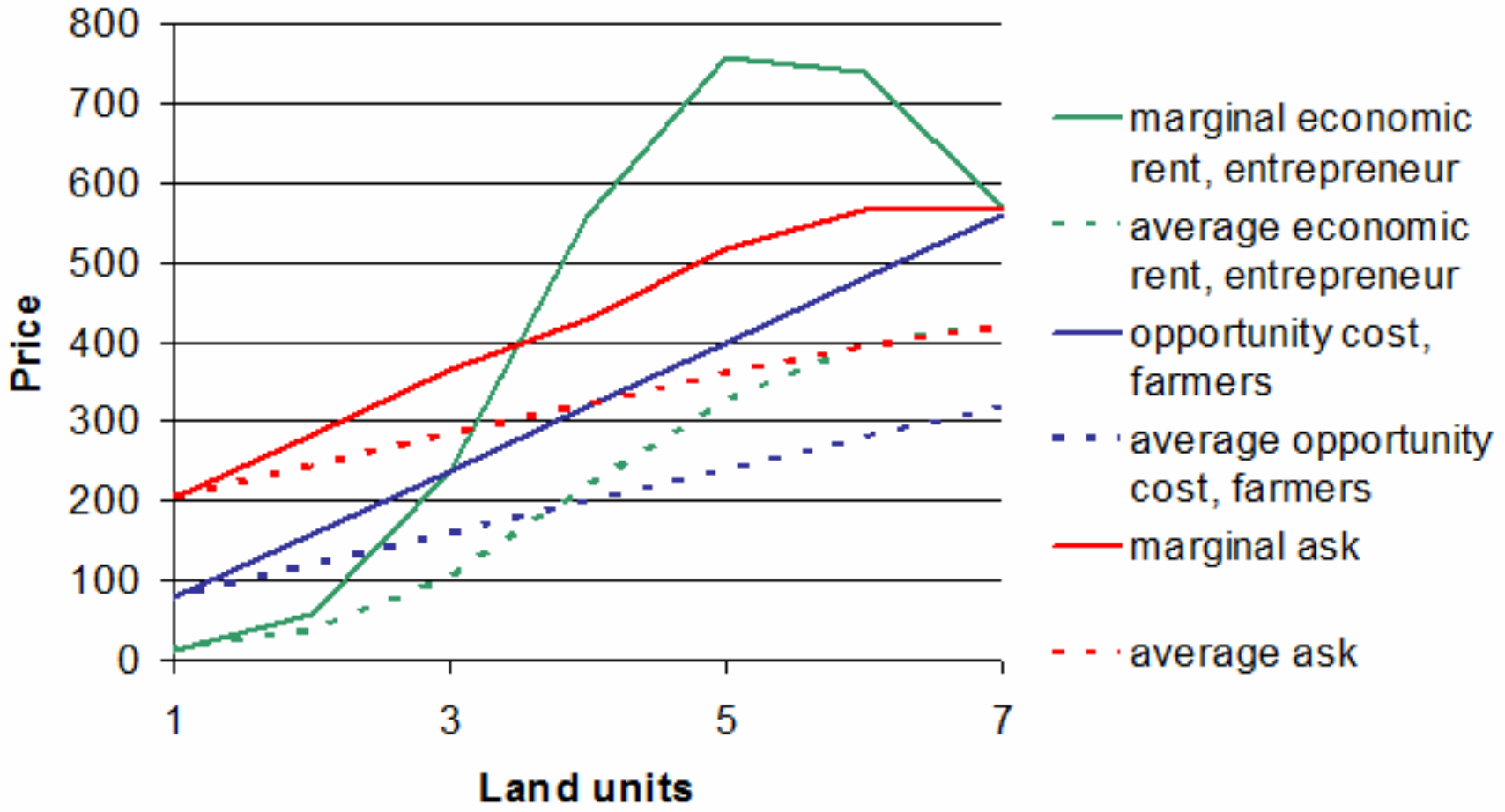
Outcome of GA: treatment 2



Benchmark case – simulations with agent-based model

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The results from the genetic algorithms, i.e. the game theoretic equilibrium, suggest that:

- The farmers/players extract all welfare gain/rent
- The rent is distributed equally among the players with the exception that no player can receive a price higher than the „market price“

Experiment results

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- Experiments were carried out in September and October 2009 with students
- Players not always playing rationally
  - Some exceptionally low asks
    - some asks lower than the opportunity cost of player (the share in each session varies between 0.4% and 8.9%)
    - behavioral explanation: analogy of winner´s curse (Thaler, 1988): people want to “win” the deal even if they loose money
  - Some exeptionally high asks
    - Asking for too much – no risk to loose
  - Possibly also typing errors

Experiment results

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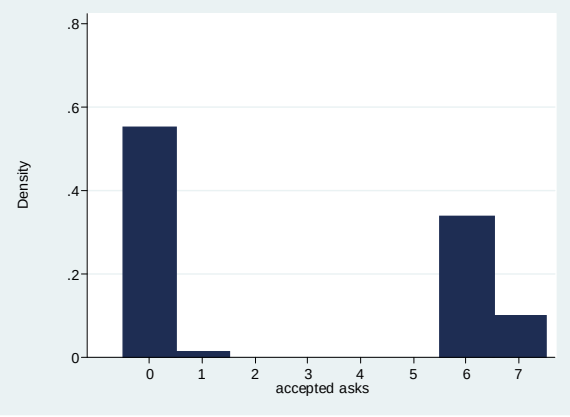
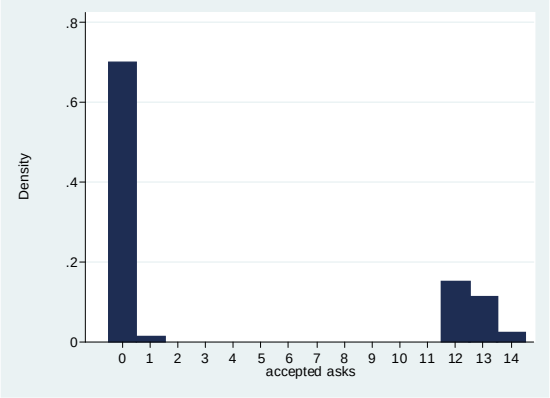
Distributions of number of accepted asks per round

Tight room for negotiation

Treatment 1

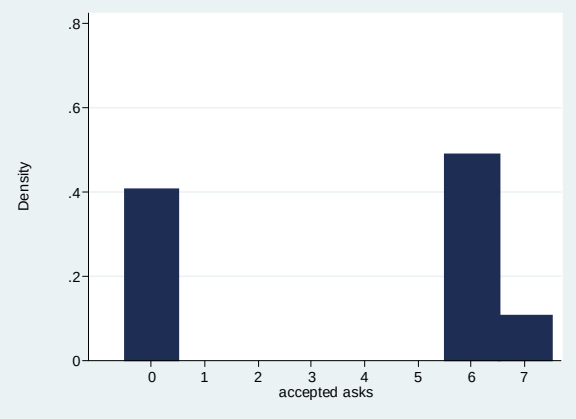


Treatment 3

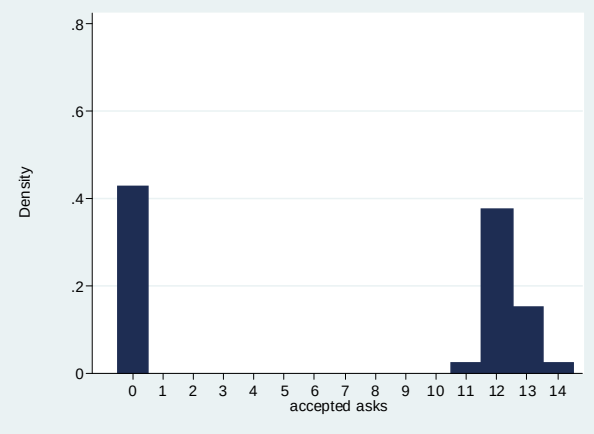


Generous room for negotiation

Treatment 2



Treatment 4



Experiment results

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Average share of accepted asks by treatment

	Treatment			
	1 7 players, tight room (N=80)	2 7 players, generous room (N=160)	3 14 players, tight room (N=80)	4 14 players, generous room (N=80)
Average share accepted asks (standard deviation)	0.39 (0.44)	0.52 (0.44)	0.26 (0.41)	0.51 (0.44)
P-value, Mann-Whitney U-test*	0.054		0.0024	

* Tests whether the data comes from two different populations (the null hyphothesis is that the two samples are drawn from identical populations)

Experiment results

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Average share of accepted asks by treatment

	Treatment			
	1 7 players, tight room (N=80)	3 14 players, tight room (N=80)	2 7 players, generous room (N=160)	4 14 players, generous room (N=80)
Average share accepted asks (standard deviation)	0.39 (0.44)	0.26 (0.41)	0.52 (0.44)	0.51 (0.44)
P-value, Mann-Whitney U-test*	0.74		0.96	

* Tests whether the data comes from two different populations (the null hyphothesis is that the two samples are drawn from identical populations)

Experiment results

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- Findings (I)
  - In general the share of accepted asks is surprisingly low
    - < 50 % in treatments with tight room for negotiation
    - ~ 50 % in treatments with high room for negotiation
    - ➢ highly inefficient outcome
  - Smaller groups are (slightly) more successful (although not statistically significant)
  - Rate of acceptance does not increase over time
    - players do not learn to coordinate (even after 40 rounds)

Experiment results

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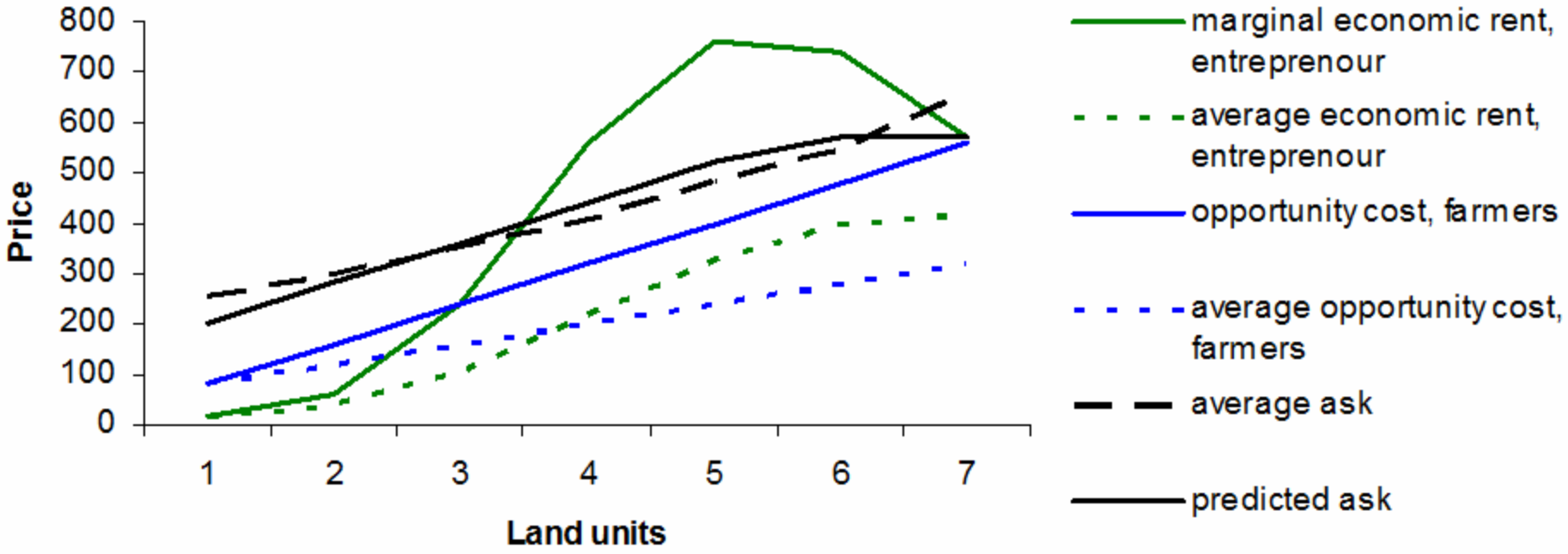
Comparison with benchmark case – Treatment 2



- in average too high asks for low and very high opportunity costs
- bidding more efficient as too high asks are more costly

Experiment results

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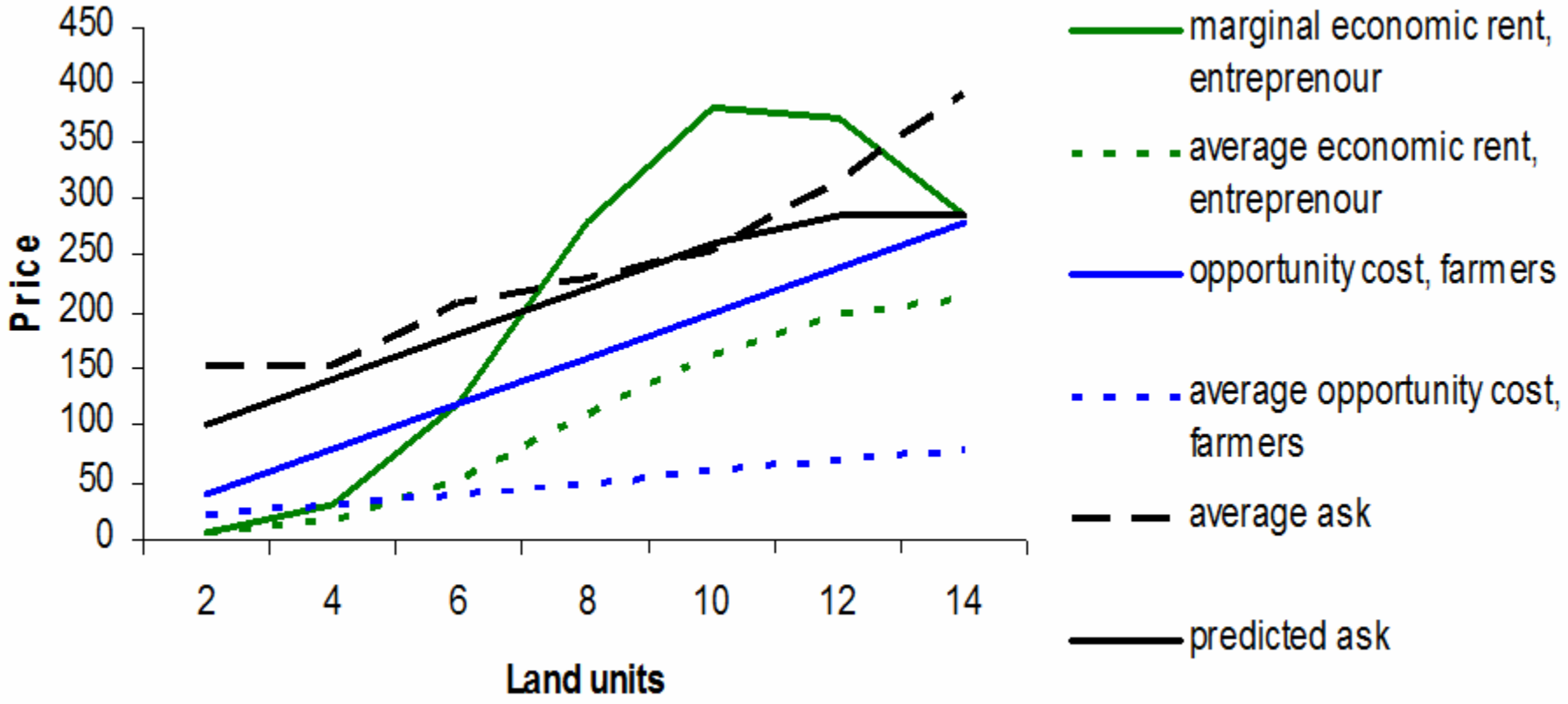
Comparison with benchmark case – Treatment 4



➢in average too high asks for lower and high opportunity costs (not just outliers)

Experiment results

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Regression results, FE-model

	Dependent variable: Ask			
	7 players		14 players	
	Tight room	Generous room	Tight room	Generous room
Constant	153000*** (22100)	166000*** (14800)	57100*** (6330)	86600*** (19000)
Opportunity cost	0.74*** (0.062)	0.83*** (0.041)	0.90*** (0.035)	0.98*** (0.11)

Experiment results

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- Findings (II)
  - Individuals consider their opportunity costs
    - „Anchoring and adjustment“ (Tversky and Kahneman, 1974).
  - Problem: mark-ups too high among low and high opportunity cost players
  - ➢ “Too high” mark-ups of low and high opportunity cost players could be related to some form of inequity aversion (Fehr and Schmidt, 1999), but with emphasis on different dimensions:
    - Low opportunity cost players: expect equal price
    - High opportunity cost players: expect to receive the same mark-up.
    - The dimensions - price and mark-up - are likely to be considered as „scarse“ or „prominent“ by the respective individual players.

Conclusions

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- The experimental results suggest that
  - Players do not reveal information although this is costly
  - Players with low and high opportunity costs generally ask for „too much“
  - When potential gain is larger, the number of accepted asks is higher, i.e., when too high asks are more costly
- Experiments provide evidence for market failures and cooperation deficits as reasons for unexploited increasing returns

Further research

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- Conduct the experiments with
  - individualized opportunity costs
  - with farmers instead of students
  - with other auction schemes (e.g. spectrum auctions)
- Identify which market mechanisms that are needed in order to support coordination so that reallocation to more efficient outcomes can be achieved.

Thank you for your attention!