SiAg

Strukturwandel im Agrarsektor

ON THE MAGNITUDE OF BOUNDED RATIONALITY IN BUSINESS MANAGEMENT GAMES

– a behavioural economic analysis of complex decision making

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Problem Description and Objectives

Problem:

- agricultural policies often do not have the desired effects
- traditional rational choice models applied by policy consultants do not allow for bounded rationality
- How much of an effect does bounded rationality have on the success of a business?

Objectives:

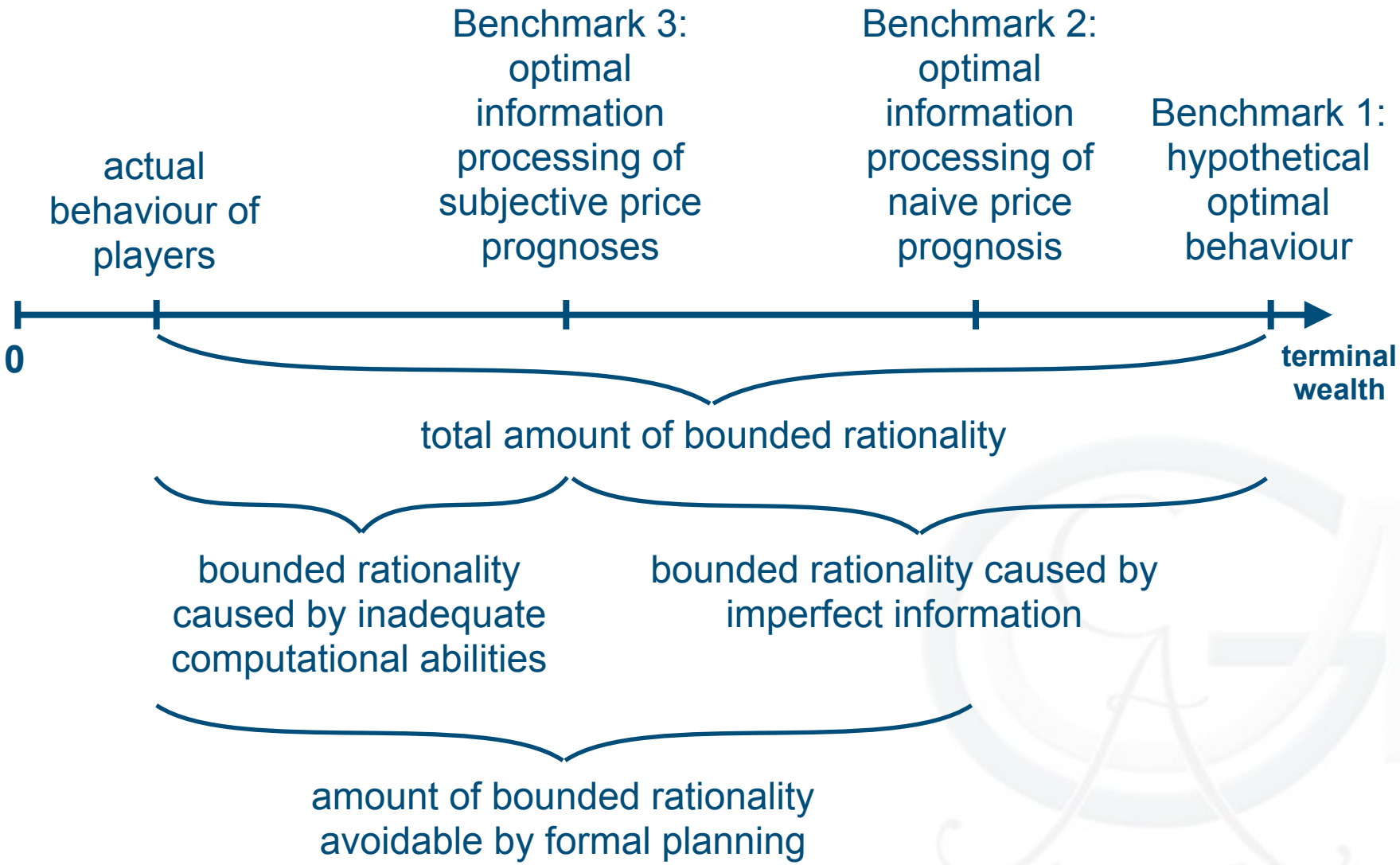
- quantify the amount of bounded rationality in complex decision-making
  - in more than one entrepreneurial domain
  - subject to dynamics
- separate the components of bounded rationality
  - inadequate information
  - limited computational abilities of decision-makers

Problem Description and Objectives

- business games provide very useful data for this approach
  - same initial situation and framework for all participants
  - comparability of decisions
  - applicability of benchmarks
  - incentive compatibility (i.e. through prices)

- properties of the business game
  - decisions in the entrepreneurial domains “investment“, “production“, “financing“
  - entrepreneurial goal: maximisation of terminal wealth
  - incentive compatibility
  - success depends on product prices, which, in turn, depend on the production activities of all players
  - benchmarks, that show the possible terminal wealth with no (less) bounded rationality are applicable for each player

Study Design – Research Approach



Study Design – The Business Game "SPOT"

- multi-period game (8 periods) with the goal to gain the highest terminal wealth

- participants have to decide on
  - investments (5 different production facilities)
  - production (2 different products: sparrows and pigeons)
  - financing (annuity loan, open credit)

- framework conditions:
  - seed capital of 2,000 MU (monetary units)
  - periodic fixed costs of 300 MU
  - price for sparrows is fixed and known:
    - periods 1-4: 13.5 MU
    - periods 5-8: 12.0 MU
  - price for pigeons:

$$P = 25 - 0.14 \times \frac{total\ \ amount\ \ of\ \ production}{number\ \ of\ \ players}$$

Study Design – The Business Game „Spatz oder Taube“

invest-ment	costs of acquisition (MU)	production capacity		useful life	production costs (MU/unit)		lending limit (%)	internal rate of return (%)[a)]
		sparrow	pigeon		sparrow	pigeon		
A	70	20 of both together		2	9	9	0	10.7
B	195	25	-	3	8	-	80	10.5
C	340	-	25	3	-	6	80	9.6
D	1.560	75	-	3	3	-	50	11.9
E	1.760	-	75	3	-	2	50	11.9

a) on a basis of 12 MU/unit sparrow and pigeon

- annuity loan:
  - bound to investments, maximum uptake = lending limit
  - interest rate: 10%, duration: 3 years
- open credit:
  - maximum 2,000 MU, interest rate: 15%, duration: 1 year
- unused capital yields interest at a rate of 4%

Study Design – The Business Game „Spatz oder Taube“

- participants had to enter their price predictions for the next 3 periods
- to ensure incentive compatibility:
  - money prices for the best 5 participants
  - 50 € for the player with the best price predictions
- SPOT was played in winter term 2008/09 (group 1) and summer term 2009 (group 2)

	number of analysed players	average time of study (in semesters)	average self-assessment of economic knowledge (1 = very good, 5 = bad)
group 1	23	4.6	2.70
group 2	23	5.8	2.86
total	46	5.2	2.78

Study Design – Normative Benchmarks

- to quantify bounded rationality, we need to compare actual behaviour with normative benchmarks
- all decisions by the benchmarks are met c.p. (no influence on actually observed prices)
- to determine the benchmarks, we use (mixed-integer) multi-period linear programming (MLP)
- depending on the benchmark, different prices / price predictions are used

Study Design – Normative Benchmarks

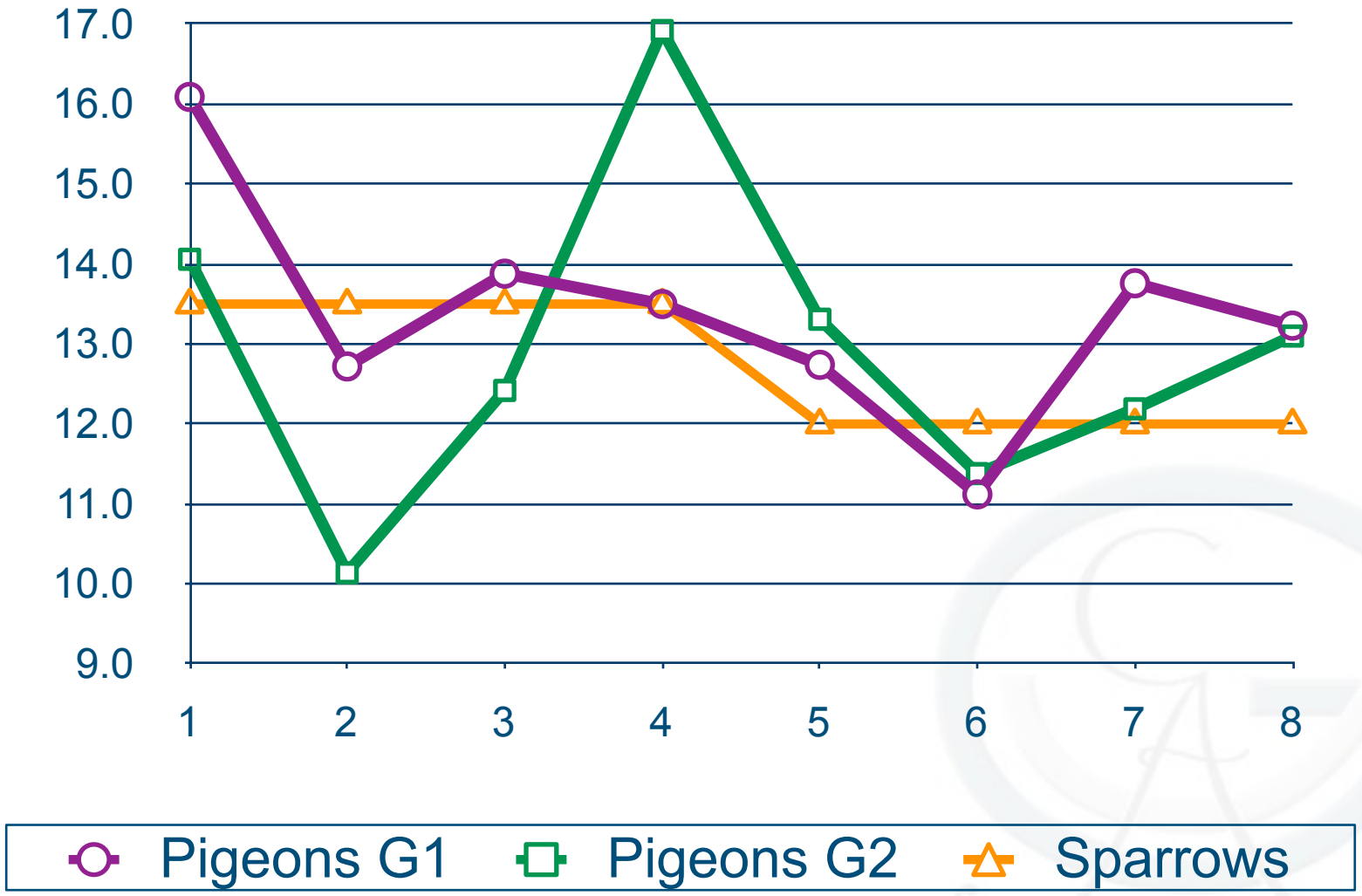
- determination of Benchmark 1:
  - use of actually observed market prices as price predictions
  - price predictions = actual prices => no need to adjust plans over time
  - can be solved in one run

- determination of Benchmarks 2 & 3:
  - use of naive price prognosis and players‘ predicted prices, using the last price prognosis for all following periods and biasing by -1.5 MU for price predictions in period 5 (analogue to the drop of sparrow prices)
  - price prediction ≠ actual prices
  - changes in future business organisation to adjust to different situation (caused by the difference between predicted and actual prices)
  - has to be solved for each period of decision-making
  - Benchmark 3 produces a different solution for each player

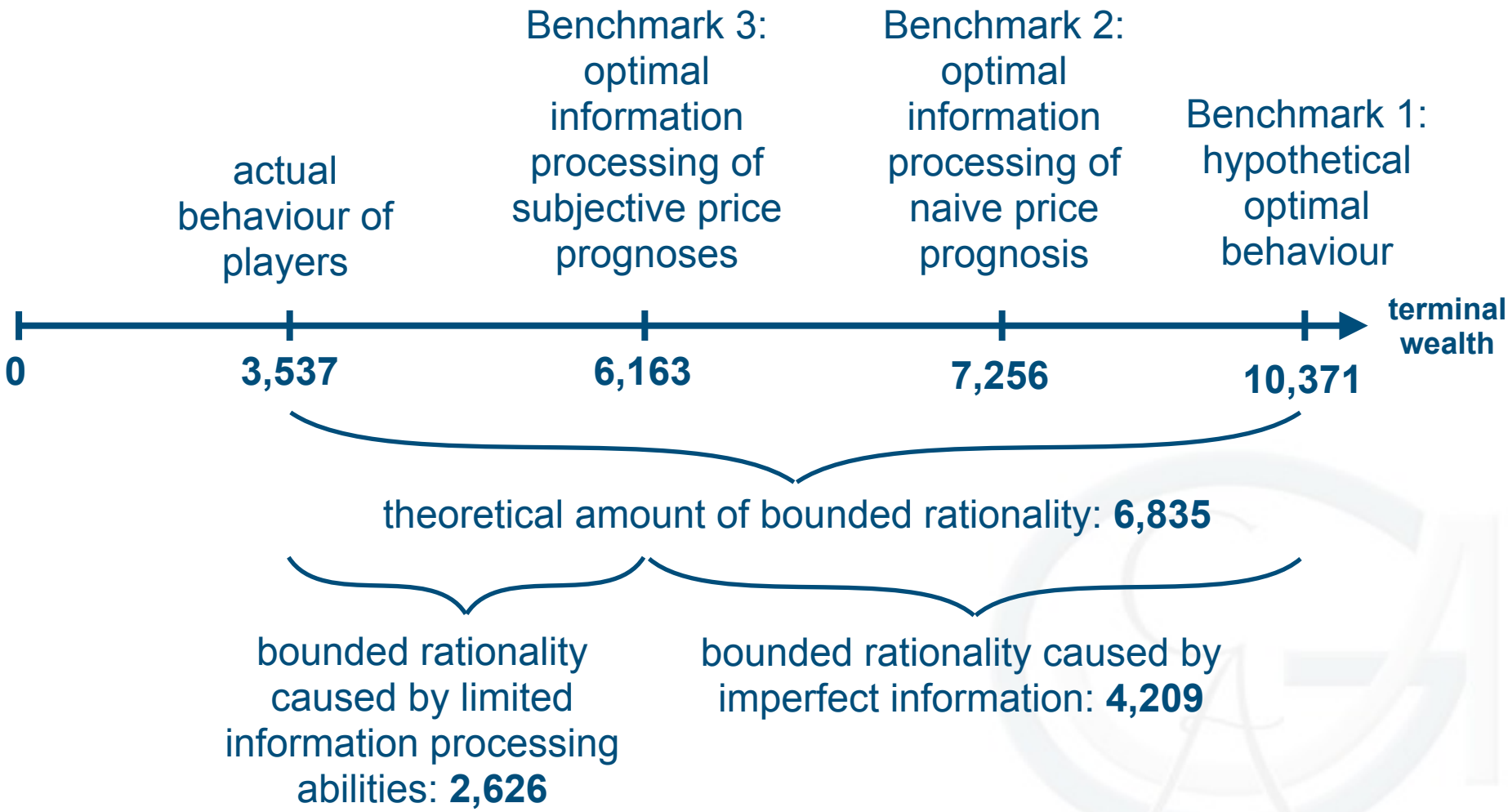
Results and the Sources of Bounded Rationality

		1	2	3	4	5	6	7
		actual terminal wealth	**Benchmark 1**		**Benchmark 2**		**Benchmark 3**	
			total	diff to 1	total	diff to 1	total	diff to 1
Group 1 (N=23)	mean	4,029	11,284	7,255	9,783	5,754	9,103	5,074
	max	8,691		2,593		1,092	10,039	1,348
	min	716		10,568		9,067	9,365	8,649
Group 2 (N=23)	mean	3,044	9,458	6,414	4,729	1,685	3,223	179
	max	5,057		4,401		– 328	777	– 4,280
	min	1,579		7,879		3,150	1,024	– 555
total mean		3,537	10,371	6,835	7,256	3,719	6,163	2,626

Results – Price Developments



Results and the Sources of Bounded Rationality



Summary

- comparison of players‘ actual behaviour with normative benchmarks (determined by formal planning)
- the improvement potential (magnitude of bounded rationality) is substantial
- realistic planning assumptions are as important as the ability to solve optimisation problems
- if inadequate assumptions are made, players can be “right for the wrong reasons“
- bounded rationality can be divided into limited information processing abilities and imperfect information.
- the impact of each component is subject to market dynamics

Summary - Implications for the Agricultural Sector

- large differences between technically equal entrepreneurs

  => formal planning paired with acquisition of good information has a great improvement potential

- policy consultants have to take into account that bounded rationality has a substantial effect on entrepreneurial decisions

  "A good policy for the wrong decision-maker is a bad policy."

- usage of business games as a lab for better prediction of policy measures

- further questions:
  - How does attitude towards risk affect bounded rationality?
  - How does bounded rationality affect entrepreneurial behaviour when faced with changing framework conditions or a change in policies?

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Thank you very much for your attention!