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# The paradoxes of fundamentalists' profits

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## Introduction

- Models with bounded rational HIAs often assume decisions are based on different information sets

- Information is often obtained by
  - past observations
  - properties (at least partially) exogenous to the process of interest

- Actual outcomes depend on interactions among agents
  - May not be consistent with actual information

## The case of fundamentalists

- Many models use fundamentalist strategies
- Agents have information about the value of a variable
- In a setup related to the price of an asset
  - if everyone is fundamentalist, the price is indeed the fundamental value
- What about if not everyone is fundamentalist?
  - Is the price level on average different from the fundamental value?
  - What about profits?

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# Asset pricing model with two types

Baseline version of Brock and Hommes (1998)

- Agents are mean variance maximisers

- Two types of strategies: fundamentalist and trend following

- Two types of assets:
    - Risk free, perfectly elastically supplied, paying interest $R$
    - Risky pays stochastic (IID) dividend $y_t$ and is sold at price $p_t$

- Assuming zero supply of outside shares, define as the *fundamental* value of the asset:

$$p^* = y/(R-1) \qquad (1)$$

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# Expected profits

- Let $x_t = p_t - p^*$ denote the deviation from the fundamental value
- Agents who pay $C$ have access to the fundamental value and expect $x_t = 0$
- Trend followers expect that $x_t$ follows a trend $g$ compared to its value in the previous period.
- Expected profits of fundamentalist and trend following strategies are

$$\pi_{f,t} = \frac{1}{a\sigma^2} Rx_{t-1}(Rx_{t-1} - x_t) - C, \tag{2}$$

where $a$ is assumed risk aversion and $\sigma^2$ is the excess return variance, and

$$\pi_{c,t} = \frac{1}{a\sigma^2}(x_t - Rx_{t-1})(gx_{t-2} - Rx_{t-1}) \tag{3}$$

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## Dynamics

Assuming a logit framework with scale parameter $\beta$, regarding choices
the fractions of fundamentalists and trend followers in each period are
given by

$$n_{f,t} = \frac{e^{\beta \pi_{f,t}}}{e^{\beta \pi_{f,t}} + e^{\beta \pi_{f,t}}} \qquad (4)$$

and

$$n_{c,t} = \frac{e^{\beta \pi_{c,t}}}{e^{\beta \pi_{f,t}} + e^{\beta \pi_{f,t}}} \qquad (5)$$
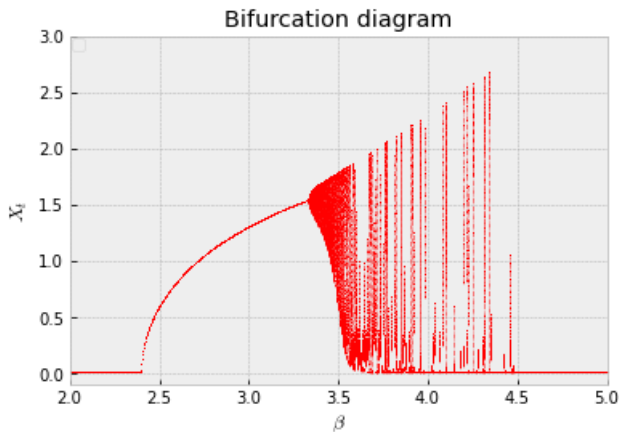
with

$$m_t = n_{f,t} - n_{c,t} = tanh \left[ \frac{\beta}{2} \left( \frac{g x_{t-2}(R x_{t-1} - x_t)}{a \sigma^2} - C \right) \right], \qquad (6)$$

and

$$R x_t = n_{c,t-1} g x_{t-1} \qquad (7)$$

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# Summary

Prices can deviate from fundamentals



Bifurcation diagram

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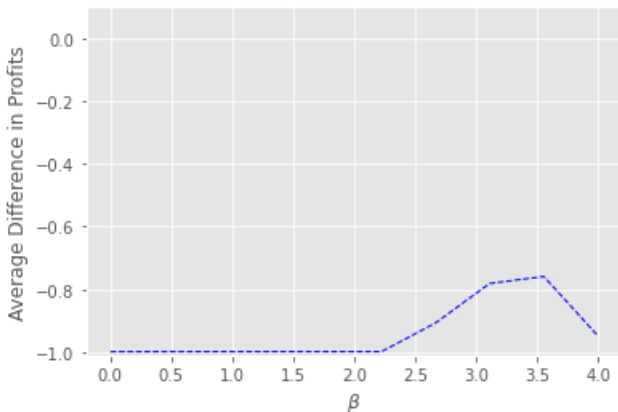●ooooooooo

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# Relative average profits

- We run the model for $N$ (10000) periods
- Calculate the average profits for each of the strategies for the whole period:

$$\hat{\pi}_h = \frac{1}{N} \sum_{t=1}^{N} [\pi_{h,t}] \qquad h = f, c$$

- Calculate $\hat{\pi}_f - \hat{\pi}_c$ for different values of
  - costs $C$
  - intensity of choice $\beta$

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# Fundamentalists gain less



- When price $x_t = 0$, $\hat{\pi}_f - \hat{\pi}_c = C$
- $\hat{\pi}_f - \hat{\pi}_c$ increases as $x_t > 0$, decreases in part of the chaotic region

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## Insights

- Is it paradoxical that fundamentalists gain less on average?

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# Insights

- Is it paradoxical that fundamentalists gain less on average?
- Not necessarily as agents change strategies over time
  - Fundamentalist strategy is less often profitable with not high profits

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# Insights

- Is it paradoxical that fundamentalists gain less on average?
- Not necessarily as agents change strategies over time
  - Fundamentalist strategy is less often profitable with not high profits
- What drives average relative profits between strategies?

## Insights

- Is it paradoxical that fundamentalists gain less on average?

- Not necessarily as agents change strategies over time

  - Fundamentalist strategy is less often profitable with not high profits

- What drives average relative profits between strategies?

- In order to get a better insight

  - Turn to $\hat{\pi}_f$ and $\hat{\pi}_c$

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# Trend followers' average profits
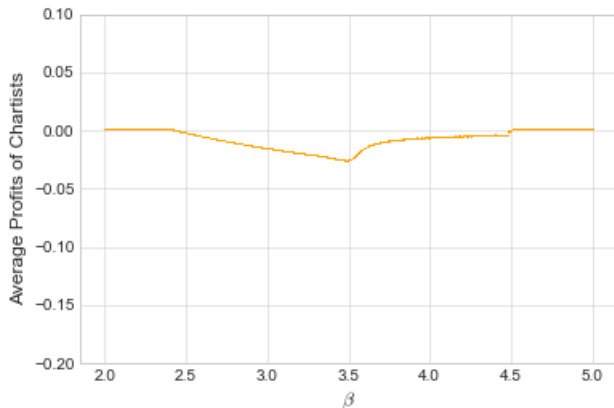


Only partially explains the difference in average profitability

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# Fundamentalists' profits
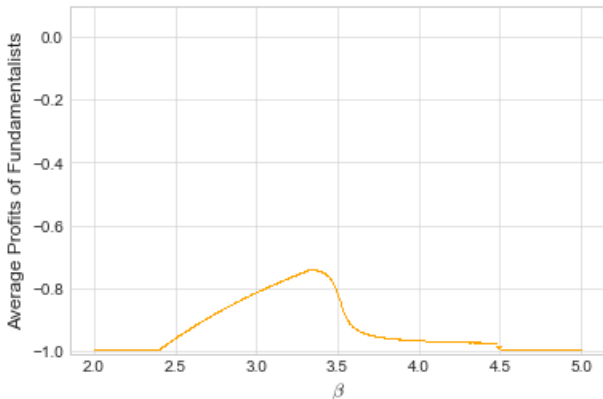


The difference is driven by the profits of fundamentalists

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## Taking stock

- Relative profits depend both on costs and intensity of choice
- For the parameter values of Brock and Hommes (1998) and low $\beta$
  - Fundamentalists gain less because it's costly
  - Difference in profits equals costs
- Higher $\beta$ when bifurcation occurs
  - Difference in profits less than costs
  - Non linear effect depending on price dynamics

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## Profitability paradoxes?

### Paradox 1

As steady state price moves away from its fundamental value, fundamentalists gain relatively more

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# Profitability paradoxes?

## Paradox 1

As steady state price moves away from its fundamental value, fundamentalists gain relatively more

## Paradox 2

Non trivial price dynamics move average price closer to fundamental value but as this happens fundamentalists relative profits are reduced

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# Profitability paradoxes?

**Paradox 1**

As steady state price moves away from its fundamental value, fundamentalists gain relatively more

**Paradox 2**

Non trivial price dynamics move average price closer to fundamental value but as this happens fundamentalists relative profits are reduced

**Question 1:** Do we still observe these with lower costs?

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# Profitability paradoxes?

### Paradox 1

As steady state price moves away from its fundamental value, fundamentalists gain relatively more
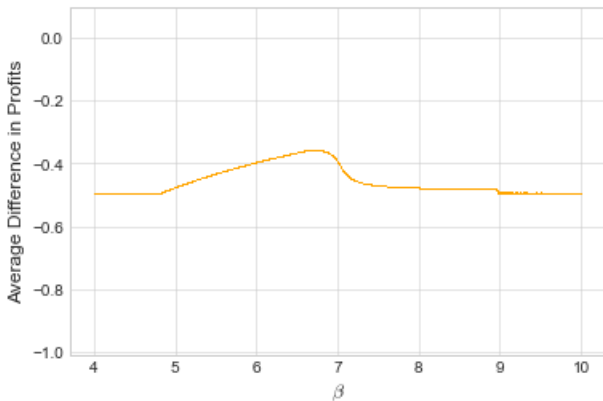
### Paradox 2

Non trivial price dynamics move average price closer to fundamental value but as this happens fundamentalists relative profits are reduced
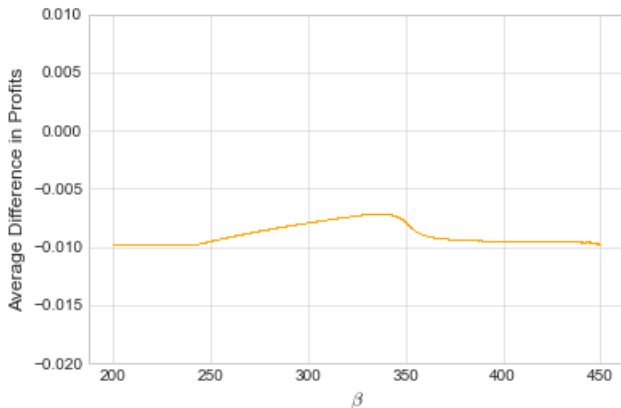
**Question 1:** Do we still observe these with lower costs?
**Question 2:** Can fundamentalists gain more?

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# Average difference profits for $C = 0.5$

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# Average difference in profits for $C = 0.01$

# Conclusion

- Fundamentalist strategy is on average less profitable than trend following one
  - Costly to bring information to the market
  - Once it's there others can benefit

- High intensity of choice for given costs
  - Makes price deviate from fundamental value but increases relative profits
  - The effect is lower when costs are lower

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# Next steps

- Explain the paradoxes
  - Initial thoughts related to how fluctuations increase trend followers' profits
- Compare results with when having fixed fractions of two populations
- Answer more questions:
  - How does noise influence the outcomes?
  - How does non-switching affects relative profitability and also prices?
  - What happens if we assume different levels of reasoning?