Behavioural factors and market makers activity

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Overview

1. Introduction
2. Experimental study
3. Econometric approach
4. Agent based model
5. Conclusions and further research
Problem

A market maker:

- assumes the risk of holding a certain number of a particular security in order to facilitate the trading of that security
- displays buy and sell quotations for a guaranteed number of a particular security

Questions:
How behavioural traits influence market makers decisions?
How behavioural traits influence chances of success in a competitive behaviour?
Information models
- emphasize the role of the informational asymmetry between market maker and the informed traders, Glosten and Milgrom (1985)

Inventory models
- relate the market makers behaviour to the current status of inventories
- objective of the market maker is to avoid bankruptcy, Garman (1976)
- objective is only maintaining an inventory balance, Stoll (1978)

Behavioural models
- the mean of prior information (optimistic/pessimistic bias)
Participants

- 88 students (63 managed to finish the experiment)
- undergraduate students (mean age around 21)
- financial engineering course (credit points)
- 7 games (each game has maximum of 25 rounds) with increasing difficulty
Game

MESSENGER

BROKER: OCT 100 puts?
MM: 3.11/3.20, 100 by 100
BROKER: I can pay 3.20 for 300
MM: 200 done
BROKER: OK

MESSENGER

BROKER: OCT 97 calls?
MM: 4.76/4.92, 100 by 100
BROKER: I can sell 300 at 4.88
MM: Not for me thanks
BROKER: OK
**BROKER: APR 100 puts**: broker asks for quotation of the European put option with a strike price 100 and maturity in April.

**MM: 3.14/3.16, 125 by 125**: market maker offers to buy 125 option contracts at a price 3.14 or to sell 125 option contracts at a price 3.16.

**BROKER: I can pay 3.16 for 300**: broker discloses her/his intention to buy 300 put option contracts at a price 3.16.

**MM: Sell the APR 125 puts at 3.16**: market maker sell 125 option contracts at a price 3.16.
Behavioural traits

- **BART (The Balloon Analogue Risk Task)**
  - average pumps when collected — risk taking

- **Jars**
  - average number of beads — conservatism

- **ultimatum game**
  - average amount proposed — fairness
  - average amount when rejects — reaction to unfairness
  - amount earned — strategic thinking

- **surveys**
  - Objective numeracy skills (ONS)
  - Subjective numeracy skills (SNS)
  - UPPS: negative urgency, lack of premeditation, lack of perseverance, sensation seeking, and positive urgency
Behaviour

Quotes
1. spread — how wide is a spread
2. skewness — how asymmetric is the spread around value

Deals
1. acceptance — what is the probability of accepting worse trade conditions?
2. volume — what part of the additional volume will be accepted?
Spread - glmmTMB package: Generalized Linear Mixed Models using Template Model Builder.

|                         | Estimate | Std. Error | z value | Pr(>|z|) |
|-------------------------|----------|------------|---------|----------|
| (Intercept)             | 0.415    | 0.909      | 0.457   | 0.648    |
| max_risk                | 0.003    | 0.000      | 7.961   | 0.000    |
| ONS                     | 3.950    | 1.501      | 2.631   | 0.009    |
| strategic_thinking      | -2.544   | 0.730      | -3.487  | 0.000    |
| fairness                | -2.274   | 1.265      | -1.797  | 0.072    |
| negative_urgency        | 5.135    | 1.216      | 4.222   | 0.000    |
| positive_urgency        | -2.487   | 0.813      | -3.060  | 0.002    |
Machine learning CART model

1. fairness
   - ≤ 0.364
   - > 0.364

2. LM 1 (972/165.172%)
3. conservatism
   - ≤ 0.424
   - > 0.424

4. max_risk
   - ≤ 43.5
   - > 43.5

5. premeditation
   - ≤ 0.439
   - > 0.439

6. SNS
   - ≤ 0.427
   - > 0.427

7. LM 2 (490/24.377%)
8. LM 3 (568/34.42%)
9. LM 4 (447/14.75%)
10. LM 5 (798/64.867%)
11. LM 6 (1274/70.587%)
Agents

- N heterogeneous market makers
- 2000 brokers connected to n market makers
- 1000 simulation steps: brokers try to buy or sell option contracts

Simulation steps

- A broker collects offers from connected market makers and selects a best offer
- A broker and selected market maker deal together
- If a market maker exceeds a risk limit for k simulation steps, he leaves the market
### Results

Chances of market maker survival (simulation step which market maker leaves the market at)

|                | Estimate | Std. Error | t value | Pr(>|t|) |
|----------------|----------|------------|---------|----------|
| (Intercept)    | 934.1959 | 3.6351     | 256.99  | 0.0000   |
| marketMakersMinimumSize | 4.3385 | 0.1707     | 25.41   | 0.0000   |
| objectiveNumeracySkills | 298.7558 | 1.8832 | 158.64  | 0.0000   |
| subjectiveNumeracySkills | 7.0242 | 1.8880 | 3.72    | 0.0002   |
| riskTaking     | -112.2909 | 1.8781     | -59.79  | 0.0000   |
| strategic      | 18.1183  | 1.8939     | 9.57    | 0.0000   |
| fairness       | -36.3360 | 1.8902     | -19.22  | 0.0000   |
| negativeUrgency| -10.4585 | 1.8894     | -5.54   | 0.0000   |
| premeditation  | -133.3661 | 1.8732   | -71.20  | 0.0000   |
| perseverance   | 12.1852  | 1.8859     | 6.46    | 0.0000   |
| sensationSeeking | -70.5796 | 1.8947 | -37.25  | 0.0000   |
| positiveUrgency | -45.8056 | 1.8889 | -24.25  | 0.0000   |
### Results

**Financial result per round (present on the market)**

| Estimate       | Std. Error | t value | Pr(>|t|) |
|----------------|------------|---------|----------|
| (Intercept)    | 29.1394    | 0.1509  | 193.07   | 0.0000   |
| marketMakersMinimumSize | -0.8411    | 0.0076  | -111.24  | 0.0000   |
| maximumStepsRiskIncreased | -0.0469    | 0.0214  | -2.19    | 0.0285   |
| objectiveNumeracySkills | -25.8631   | 0.0834  | -310.13  | 0.0000   |
| riskTaking     | -5.4074    | 0.0831  | -65.05   | 0.0000   |
| strategic      | 0.9129     | 0.0838  | 10.89    | 0.0000   |
| fairness       | 18.7894    | 0.0837  | 224.57   | 0.0000   |
| negativeUrgency| 3.5667     | 0.0836  | 42.65    | 0.0000   |
| premeditation  | -8.6346    | 0.0829  | -104.10  | 0.0000   |
| sensationSeeking | -1.9446    | 0.0838  | -23.21   | 0.0000   |
| positiveUrgency| -1.3494    | 0.0836  | -16.14   | 0.0000   |
Conclusions

- In general, behavioural traits decrease chances of market makers survival on the financial markets.

Further research

- Other machine learning algorithms for marker makers
- Benchmarking with professional market makers data
Thank you