Pricing algorithms

Competition & Enforcement Implications

The views expressed are personal and do not necessarily reflect those of the Authority
IN THE PAST...

- War strategy in the First World War based on offensive operations
- Degenerated into a prolonged stalemate (trench warfare from 1914 to 1918)
IN THE PAST...

- The war strategy failed to appreciate the impact of new technologies
NOWADAYS

- Some new digital players
Nowadays

- How we risk to see them
THE NEW TECHNOLOGY

Artificial intelligence

Machine learning

Deep learning
MACHINE LEARNING
THE STORY OF LIBRATUS (CARNEGIE MELLON UNIVERSITY)

- First stage
  - Libratus learns the rules of poker and plays against itself

- Second stage
  - Libratus plays against humans and selects the most suitable strategies
Third stage

- Humans find Libratus’ patterns and adapt their strategies
  → Libratus learns to bluff!

Test in January 2017, Texas hold’em tournement
Winning rate 14.7%
Earned $1.8 millions in 120,000 hands
Deep learning
The story of AlphaZero

- 11 May 1997
  - IBM Deep Blue beats Garry Kasparov

- 5 December 2017
  - DeepMind (Google) AlphaZero defeats Stockfish and Elmo
28 wins, 72 draws

Stockfish: 70 million positions per second

AlphaZero: 80,000 positions per second
Deep learning
AlphaZero VS Stockfish

- AlphaZero compensates by using its deep neuronal network and focus more selectively on the most promising options

Article «Mastering Chess and Shops by Self-Play with a General Reinforcement Learning Algorithm»

- To learn and defeat Stockfish, AlphaZero took... 4 hours!
PRICING ALGORITHMS AND COMPETITION
53% track online prices of competitors, of which

- 67% with software
- 78% subsequently adjust prices
  - 43% only manually
  - 27% manually and automatically
  - 8% fully automatically

Track online prices of retailers as well
Online markets are characterised by high degree of transparency

Demand side: consumer can quickly compare prices (comparison tools)

Supply side: identify best positioning, dynamic pricing strategies
- Collection and processing of personal and behavioural data
- **Demand side**: targeted offers and services
- **Supply side**: personalised pricing
COMPETITION CONCERNS

- Algorithms may increase the ability and incentives to reach, monitor and enforce explicit and tacit collusion
COMPETITION CONCERNS
ABUSE OF DOMINANCE

- Use ranking to the detriment of competitors
- Illegal price discrimination?
COMPETITION CONCERNS
COLLUSION

- If algorithm is a tool to **increase effectiveness** of explicit collusion → nothing new
  - Equivalent of ‘outsider’ managing the agreement
  - Two recent cases of ‘outsider’ in the concrete sector in Italy
COMPETITION CONCERNS
COLLUSION

If algorithm is the tool for information exchange → concerted practice

«Fall short of a formal agreement but consists of some form of coordination that consciously replaces the risk of competition with cooperation»
COMPETITION CONCERNS
COLLUSION

Proving a concerted practice

- Circumstancial evidence that shows the intrinsic oddity of the conduct
- Serious, precise and consistent indications of collusion
- ‘Narrative consistency’: Authority’s reconstruction should be preferable to any alternative hypothesis

In case of evidence of contacts between the parties → burden of proof shifts on the parties
## COMPETITION CONCERNS COLLUSION

<table>
<thead>
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<th>Cartel</th>
<th>Coordinated interaction</th>
<th>Conscious parallelism</th>
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<tr>
<td><strong>Evidence</strong></td>
<td>Formal agreement</td>
<td>Qualified contacts/info exchange</td>
<td>Circumstantial evidence</td>
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<td><strong>Assessment</strong></td>
<td>Infringement</td>
<td>Type of information/effects</td>
<td>Intrinsic oddity of the conduct</td>
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<td><strong>Burden of proof</strong></td>
<td>Parties</td>
<td>Agency/Parties</td>
<td>Agency</td>
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CONCERTED PRACTICE?
COMPETITION CONCERNS
COLLUSION

- Airline fuel surcharge
- The big four

Italian cases
OUTSTANDING ISSUES
COLLUSION

- Detection → market inquiry and data specialists
- Collusive conducts may arise in fragmented markets, too
- Algorithms’ self learning → liability?
COMPETITION CONCERNS
ABUSE OF DOMINANCE

- EC Google Shopping case: abusing dominance as search engine by giving illegal advantage to own comparison shopping services

- Booking case: algorithms and MFN

- The role of consumer protection (comparison tools)
OUTSTANDING ISSUES
ABUSE OF DOMINANCE

- Relevant market and market power
- Algorithm is a business secret
- Overall effects of first-degree price discrimination?
  - E.g. risk markets
- Intersection with privacy and consumer protection
thank you