COMPETITION POLICY IN THE DIGITAL ERA

with a special focus on the challenges raised by

ALGORITHMS

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OECD, Competition Division
OUTLINE

• DIGITALISATION
  – OECD’s WORK ON DIGITALISATION

• ALGORITHMS
  – RISKS AND BENEFITS
  – ALGORITHMS & COLLUSION
  – CHALLENGES
  – REMEDIED?

• POLICY IMPLICATIONS
DIGITALISATION
“Digital transformation is characterized by a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services.” - European Commission

"The industrial revolution of our time is digital. We need the right scale for technologies such as cloud computing, data-driven science and the internet of things to reach their full potential. As companies aim to scale up across the Single Market, public e-services should also meet today's needs: be digital, open and cross-border by design. The EU is the right scale for the digital times.“ - Andrus Ansip, EU Commissioner, Vice-President for the Digital Single Market, Brussels 19 April 2016
“The digitalisation of our economy, of our society, of our daily lives is, as we all know, having a huge effect on all aspects of human endeavour. It’s surely not surprising, then, that this should include our own field of endeavour, competition or ‘antitrust’ law and policy.” - CMA, 15 November 2016

“Competition rules can't solve every problem on their own. But they can make an important contribution to keeping digital markets level and open. So that consumers get innovative products at the right prices. And so that digital entrepreneurs, however big or small, have a fair shot at success.” - Margrethe Vestager, Munich, 17 January 2016
DIGITAL ECONOMY

• Umbrella term
“…the part of an economy that enables and conducts the trade of goods and services through e-commerce” (OECD Hearing on the Digital Economy, 2012)

BUT
• Traditional (offline) vs digital (online) world is interconnected and integrated -> no clear boundaries
• Impacts of the digital economy spill over to other areas and to the society
CROSS-BORDER DIGITALISATION

- Cross border digitalisation leads to market integration, promotes international trade and enables new data-driven business models that promote competition and economic growth.

Potential benefits from enhanced competition:

- Lower prices
- Quantity, quality & variety of services
- Product and process innovation
Digital platforms have served as the basis for many disruptive innovations (taxis, hotels, financial services, legal services…):
- Cutting out intermediaries and reducing costs
- Providing flexible employment opportunities
- Addressing market failures normally dealt with by regulation

Data analytics has enabled multiple innovations with benefits for firms and consumers:

Applications of Big Data & Algorithms
- New products & services
- Personalised recommendations
- Supply-chain optimisation
- Product recommendations
- Dynamic pricing
- Fraud prevention
- Risk management
- Product customisation
- Real-time supply
- Consumer information
• Gains from digitalisation can also be captured by developing economies:
  – Countries without the infrastructure can benefit from the computational power and software developed elsewhere
  – Dissemination of data promotes economic convergence (e.g. data from country A can be analysed by country B to improve policies in country C)
  – Cross-border digitalisation exerts competitive pressure on established national monopolies

Inclusive growth
BUT CROSS-BORDER DIGITALISATION ALSO BRINGS NEW CHALLENGES FOR COMPETITION POLICY...

- Dominance of online platforms
- Non-price competition
- Concentration of data holdings
- Blurring of market boundaries
- Competition for the market
- Rapid market changes
- Algorithmic pricing
- High transparency
- Disruptive innovation
Digital markets are characterised by **economies of scope**, **economies of scale** and **network effects** that can lead to market power and enable new anti-competitive strategies:

- **Anti-competitive mergers**
  - Strategic acquisition of potential disruptors

- **Abuse of dominance**
  - Exploitative
  - Exclusionary
  - Use of online platforms to exclude competitors from the market
  - Reduced competition in quality dimensions, such as privacy

- **Collusion**
  - Use of algorithms to facilitate collusion
OECD’s WORK ON DIGITALISATION
(1) OECD-wide work: GOING DIGITAL

Our ambition

“The OECD's Going Digital project will give policymakers the tools they need to help their economies and societies prosper in a world that is increasingly digital and data-driven.”

#Going Digital

Just released

OECD Digital Economy Outlook 2017: What artificial intelligence really means for policy makers

Published on October 11, 2017

http://www.oecd.orggoing-digital/
OECD’S WORK ON DIGITALISATION

(2) COMPETITION PERSPECTIVE

- DIGITAL ECONOMY -> long-term strategic theme of the Competition Committee

Sub-streams:

1. Relationship between the digital economy, competition law and innovation
2. Challenges posed to antitrust tools and approaches
3. Practical challenges to competition enforcement
4. Detailed industries and sectors
5. Role of competition vs regulation

OECD’S WORK ON DIGITALISATION
(2) COMPETITION PERSPECTIVE CON’T

- Policy discussions, hearings, roundtables related to the Digitalisation

<table>
<thead>
<tr>
<th>General policy issues</th>
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<tbody>
<tr>
<td>✓ Merger review in emerging high innovation markets (2002)</td>
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<tr>
<td>✓ Competition, patents and innovation (2006, 2009)</td>
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<tr>
<td>✓ The digital economy (2012)</td>
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<td>✓ Disruptive innovation in competition law enforcement (2015)</td>
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<tr>
<td>✓ Disruptive innovation and their effect on competition (2015)</td>
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<tr>
<td>✓ Big Data: Bringing competition policy to the digital era (2016)</td>
</tr>
<tr>
<td>✓ <strong>Algorithms and collusion (2017)</strong></td>
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<tr>
<td>✓ Rethinking the use of traditional antitrust enforcement tools in multi-sided markets (2017)</td>
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<table>
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<tr>
<th>Sector specific topics</th>
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<tr>
<td>✓ Vertical restraints in online sales (2013)</td>
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</table>
SPECIFIC FEATURES OF THE DIGITAL ECONOMY

- **CONSTANT CHANGE**
- **HIGH R&D COSTS**

**DATA & COMPUTING POWER**

- **GROWTH & IMPORTANCE OF DATA, ALGORITHMS**

**INNOVATION**

**PLATFORM-BASED BUSINESS MODELS**

**NETWORK EFFECTS**

- **“BANDWAGON EFFECT”**
- **SCALE ECONOMIES**

- **TWO OR MULTI-SIDED MARKETS**
“An algorithm is an unambiguous, precise, list of simple operations applied mechanically and systematically to a set of tokens or objects. (...) The initial state of the tokens is the input; the final state is the output.”

HOW CAN ALGORITHMS BE REPRESENTED?

• Plain language
• Diagrams
• Voice instructions
• Computer codes
  – Automatic
  – Fast processing
  – Complex calculation
PROGRAMMING PRINCIPLES

• Artificial intelligence
  – Detailed algorithms that mimic human intelligence, “the science and engineering of making intelligent machines” (John McCarthy, 1956)

• Machine learning
  – Algorithms that iteratively learn from data, “the ability to learn without being explicitly programmed” (Samuel, 1959)
  – Learning patterns: supervised, unsupervised, reinforcement

• Deep learning
  – Artificial neural networks that replicate the activity of human neurons…
MACHINE LEARNING (ML) VS DEEP LEARNING (DL)

• Difference: ability to process raw data
• ML requires manual features engineering, while in DL feature engineering is automatic…

Source: Moujahid (2016)
MAIN AREAS OF USE - APPLICATIONS

Widespread use of algorithms in every aspect of our life

**Business**
- Predictive analytics
- Process optimisation

**Consumers**
- Consumer information
- Decision-making optimisation

**Government**
- Crime detection
- Determine fines and sentences

**SIGNIFICANT IMPACT ON**
✓ day-to-day business operations
✓ commercial and strategic decision-making
POSITIVE IMPACTS -> BENEFITS

- Pro-competitive use of algorithms by businesses

Predictive analytics

- Supply-chain optimisation
- Target ads
- Fraud prevention

Optimisation of business processes

- Product innovation
- Risk management
- Recommendations
- Dynamic pricing
- Price differentiation
- Product customisation

Positive impact on static and dynamic efficiency !!!!!
ALGORITHMS may transform business models, decision-making process and commercial interactions

- They can facilitate the exercise of market power ➔ Abuse of dominance
- algorithms change certain structural characteristics of the market ➔ increase the likelihood of collusion
- enable new forms of collusion ➔ “ALGORITHMIC COLLUSION”

“Algorithmic collusion consists in any form of anti-competitive agreement or coordination among competing firms that is facilitated or implemented through means of automated systems.”

OECD: Roundtable on Algorithms and Collusion, June 2017
• Preconditions of collusion
  1) Common understanding / common policy
  2) Internal stability – monitor the adherence to this common policy; and enforce the common policy by punishing any deviations
  3) External stability – monitor and target new entrants

• Relevant factors that increase the likelihood of collusion
  ✓ structural characteristics
  ✓ demand-side variables
  ✓ supply-side variables

ALGORITHMS AND THE RISK OF COLLUSION
### Relevant factors for collusion

<table>
<thead>
<tr>
<th>Structural characteristics</th>
<th>Number of firms</th>
<th>±</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Barriers to entry</td>
<td>±</td>
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<tr>
<td></td>
<td><strong>Market transparency</strong></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td><strong>Frequency of interaction</strong></td>
<td>+</td>
</tr>
<tr>
<td>Demand variables</td>
<td>Demand growth</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Demand fluctuations</td>
<td>0</td>
</tr>
<tr>
<td>Supply variables</td>
<td><strong>Innovation</strong></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>Cost asymmetry</strong></td>
<td>-</td>
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</tbody>
</table>

Legend: + positive impact; - negative impact; 0 neutral impact; ± ambiguous impact
ALGORITHMS - THE RELEVANT FACTORS FOR COLLUSION

• Despite the ambiguous effects on the some factors for collusion - algorithms change certain structural characteristics of the market, such as TRANSPARENCY and FREQUENCY OF INTERACTION.

• Intuition:
  – If markets are transparent and companies react instantaneously to any deviation, the payoff from deviation is zero -> COLLUSION CAN ALWAYS BE SUSTAINED AS AN EQUILIBRIUM STRATEGY.

• Clear risk that current changes in market conditions may facilitate anti-competitive strategies:
  ➢ similarities with the classic ‘oligopoly problem’ BUT tacit collusion could become sustainable in a wider range of circumstances -> expanding the oligopoly problem to non-oligopolistic market structures.
## ALGORITHMS and “TRADITIONAL” CARTELS

<table>
<thead>
<tr>
<th><strong>Coordination</strong></th>
<th>Algorithms coordinate parallel behaviour by programming prices to follow a leader; or using the same third party algorithm.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monitoring &amp; punishing</strong></td>
<td>Algorithms collect and process information from competitors and punish deviations</td>
</tr>
<tr>
<td><strong>Signalling</strong></td>
<td>Algorithms disclose and disseminate information in order to announce an intention to collude and negotiate the common policy.</td>
</tr>
</tbody>
</table>
C:\ Monitoring algorithm

Description: Collect and process information from competitors to monitor their compliance and, eventually, to punish deviations.

Legend:

/\bar{p} <collusive price>

/\bar{p}_i <price set by firm i>
PARALLEL ALGORITHM

C:\ Parallel algorithm

Description: Coordinate a common policy or parallel behaviour, for instance by programming prices to follow a leader.

Legend:

/\bar{p} <collusive price>

/p_i <price set by firm i>
Description: to disclose and disseminate information in order to announce an intention to collude or negotiate a common policy.

Legend:

\( /\tilde{s} \) <tentative signal>

\( /s_i \) <signal sent by firm \( i \)>
• Is the legal framework on anti-competitive agreements suitable to assess algorithms?

  => Agencies can rely on existing rules on anti-competitive agreements

  => Algorithms ought to be assessed together with the main infringement that they help enforcing.

• Challenges relate to:
  – Detection and evidence
  – Understanding how the technology works
Algorithms maximise profits while recognising mutual interdependency and readapting behaviour to the actions of other market players.

**Cooperative equilibrium**

**ALGORITHMS** and “NEW” FORMS OF TACIT COLLUSION?

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**Firm**

**Inputs**

**BLACK BOX**

**Collusive output**

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C:\ Self-learning algorithm

Description: maximise profits while recognising mutual interdependency and readapting behaviour to the actions of other market players

...
ALGORITHMS and “NEW” FORMS OF TACIT COLLUSION? – WHAT ARE THE CHALLENGES?

• Is the legal framework on anti-competitive agreement suitable to assess algorithms?
  
  => Tacit collusion is not covered by the legal framework

• Policy question:
  
  => Should we adjust the legal framework?
  => How?
The only time we look at tacit collusion is when we look at ex ante analysis of mergers. Here we have an interesting question about legality and policy (...) The fact that [algorithms] can change the market characteristics gives rise to concern. That concern cannot be attacked under 101. Should we do something about it?

Ariel Ezrachi

(...) if we don’t know the importance and the magnitude of the problem then it is very difficult to conclude that there is an enforcement gap.

BIAC

Competition laws were designed to deal with human facilitation of parallel conduct. (...) However, in a world in which tacit collusion becomes or is operated on a larger scale, maybe we need to rethink the reasons why we decided not to tackle tacit collusion in the first place.

Michal Gal
SUMMING UP – POSSIBLE RISKS OF ALGORITHMIC COLLUSION

- Algorithms
  - Change in the structural characteristics of the market
    - Transparency
    - Frequency of interactions
  - Enable new forms of collusion
    - Coordination
    - Signalling
      - Monitoring & punishing
      - Cooperative equilibrium
  - Increase the likelihood of collusion
  - Replace the need for explicit communication

Algorithmic tacit collusion
EVIDENCE OF ALGORITHMIC COLLUSION

• The case of online sale of posters on Amazon marketplace (DOJ & CMA)
  – The conspirators designed and shared among each other dynamic pricing algorithms, which were programmed to act in conformity with their agreement
  – International co-operation between the DOJ and CMA to solve the case
  – This is the first (and so far the only) case of algorithmic collusion detected by a competition authority and resulting in criminal prosecution

“Today’s announcement represents the Division’s first criminal prosecution against a conspiracy specifically targeting e-commerce (...) We will not tolerate anticompetitive conduct, whether it occurs in a smoke-filled room or over the Internet using complex pricing algorithms.”

Bill Baer, Assistant Attorney General, DoJ
FURTHER EVIDENCE: investigations, market studies and sector inquires

• Investigation of the airline tariff case by the DoJ in the 90s
  – Airline companies used a computer platform to signal price changes and exchange detailed information.
  – The case was closed with a settlement agreement.

• E-commerce sector inquiry by the European Commission
  – 50% of the retailers reported tracking prices of online competitors, 70% of which use automatic software to monitor and often to reprice their products.

• Two investigations by the Italian Competition Authority (AGCM)
  – Online comparison websites and sellers of the advertised products entered into partnership agreements that could raise conflicts of interest.
  – The AGCM accepted binding commitments by the parties to make the comparison website more clear and transparent.
FURTHER EVIDENCE: investigations, market studies and sector inquires

• Investigation by the Ukrainian Competition Authority (AMCU)
  – The distribution networks under investigation were setting prices using private information about competing networks.
  – The exchange of information was supported by a market research agency and it was conducted mostly through online means.

• Information gathering by the Federal Antimonopoly Service of Russia
  – Information collected from users and developers of price-optimisation software suggests that resellers are using different price-setting products, some of which pose a threat of facilitating coordination.
  – The FAS Russia is now doing dawn raids based on the information gathered and complains received.

• Studies by the Competition Commission of Singapore (CCS)
  – Economic evidence that algorithms facilitate tacit collusion.
  – The CCS is conducting now further work to evaluate how data collection and analytics are evolving in some selected industries.
“Although the use of algorithms by companies is widespread in certain industries, the use of complex algorithms based on deep learning principles may still be relatively rare across traditional sectors of the economy. At the moment, there is still no empirical evidence of the effects that algorithms have on the actual level of prices and on the degree of competition in real markets. This is an area where future research will be certainly welcomed to inform policy choices that governments will be facing.”

OECD, Algorithms and Collusion, 2017
“algorithms play an ever increasing role in a number of fields in which we have to keep our eyes and ears and minds open. That also goes for cartel behavior where algorithms can play a role in collusion. We see this also in other circumstances. [...] So we need to follow up on this. We need to understand how this works. The rules that we have allow us to address the issues stemming from algorithms because the basic rule is obviously that what is illegal in the analog world is also illegal in the digital world.”

Johannes Laitenberger, June 2017

“Collusion via AI still a cartel - We follow a simple principle. If a conduct is illegal in our brick-and-mortar world – for instance, a price-fixing cartel – it is equally illegal when it is carried out through software. A company can never hide behind an algorithm.”

Johannes Laitenberger, Consumer and Competition Day, Malta, 24 April 2017

“Illegal collusion isn't always put together in back rooms. There are many ways that collusion can happen, and some of them are well within the capacity of automated systems. [...] So as competition enforcers, I think we need to make it very clear that companies can’t escape responsibility for collusion by hiding behind a computer program. The challenges that automated systems create are very real.”

M. Vestager, Bundeskartellamt 18th Conference on Competition, Berlin, 16 March 2017
SO FAR DETERRENCE BY WARNING
Pricing algorithms may increase price competition, but potentially …

- Facilitate horizontal collusion
- Hub and spoke (usage of same algorithm)
- Incentivize RPM practices
- Tacit collusion?
- Artificial Intelligence?

(from Thomas Kramler, DG COMP)
“Hey, my sensors detect that you are scanning my cards!”
ANTI-COMPETITIVE MOTIVES VS NORMAL BUSINESS PRACTICES

• Digital business models blur the lines between legal vs illegal practices

• ALGORITHMS expand the *grey area* between explicit collusion (unlawful) and tacit collusion (lawful)

• Establishing a possible infringement requires evidence suggesting that *competitors have not acted independently*
  
  • Evidence of explicit agreement
  
  or

  • Evidence of parallel conduct AND “plus factors” (e.g. facilitating practices)

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NOTION OF AGREEMENT

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<tr>
<th>EU</th>
<th>US</th>
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<tbody>
<tr>
<td>“agreement”</td>
<td>“concurrence of wills between economic operators”</td>
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Existing concepts provide little guidance whether more subtle forms of communication fall in the scope of application of the competition rules.

Should legislators create a more clear definition of agreement, in order to capture “algorithmic collusion”?

“(…) computer technology that permits rapid announcements and responses has blurred the meaning of 'agreement' and has made it difficult for antitrust authorities to distinguish public agreements from conversations among competitors.” Borenstein (1997)
Can antitrust liability be established when business decisions are made by machines rather than by companies (human beings)?

• Thin line between the agent (algorithm) and the principal (human being)

• Defining a benchmark for illegality requires assessing whether any illegal action was anticipated or predetermined = > programming instructions, available safeguards, reward structure…
  – Who is liable for the decisions and actions of algorithms?
    • Creators
      – programmers or third party data-centres
    • Users
      – consumers or companies
    • Beneficiaries
      – companies or other stakeholders
<table>
<thead>
<tr>
<th>Market studies &amp; investigations</th>
<th>Ex-ante merger control</th>
<th>Commitments &amp; remedies</th>
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<tbody>
<tr>
<td>• Obtain empirical evidence of algorithmic collusion</td>
<td>• Reconsider the threshold of intervention</td>
<td>• Design remedies to prevent the use of algorithms as facilitating practices</td>
</tr>
<tr>
<td>• Identify markets and sectors that are not functioning well</td>
<td>• Evaluate the impact of transactions on market transparency and high frequency trading</td>
<td>• Apply “notice-and-take-down” processes</td>
</tr>
<tr>
<td>• Define appropriate measures</td>
<td>• Account for multi-market contacts in conglomerate mergers</td>
<td>• Introduce auditing mechanisms for algorithms?</td>
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POSSIBLE COUNTER MEASURES

Prof. Ezrachi discusses possible counter measures that can be considered in the future (while recognising their limitations):

– De-acceleration measures restricting the frequency of price changes
– Disruptive algorithms implemented by competition agencies to destabilise the market
– Sponsored entry of maverick firms to break cartels
– Secret discounts systems…
In addition to possible legal measures, Prof. Gal proposed some market solutions, such as:

- “the use of algorithms by consumers in order to counteract at least some of the effects of the algorithmic facilitated co-ordination by suppliers.”
ALGORITHMIC CONSUMERS

**Aggregators**
- Price comparison
- Quality evaluation
- Information about new products

**Digital butlers**
- Analysis of consumer preferences
- Product search
- Transaction execution
- Collective purchases

**Consumer information**

**Buyer power**

**Decision-making**
REGULATION OF ALGORITHMS?
The use of automated computer systems to organise and select relevant information affects fundamental structures of the society…

“(…) these days, a third of all marriages start on the Internet, so there are actually children alive today that wouldn’t have been born if not for machine learning.”

Domingos (2017)
REGULATION AS A POSSIBLE SOLUTION?

- Information bias
  - Social media that results in “echo chambers”
  - Product recommendations based on past purchases

- Censorship
  - Content-control software to block specific information

- Manipulation
  - Manipulation of feedback scores
  - Manipulation of rankings in search engines’ results

- Privacy rights
  - Automatic collection of personal data for target ads

- Property rights
  - Collection, use and share of information protected by IP rights, such as music and video

- Discrimination
  - Price and product discrimination based on social characteristics
CHALLENGES - Potential market failures?

Imperfect Information

• Lack of algorithmic transparency
• Algorithms as trade secrets
• Complexity of program codes

Data-driven barriers to entry

• Scale economies of IT infrastructures
• Scope economies of datasets
• Network economies in online platforms

Spill-overs

• Information and knowledge as a public good
CHALLENGES – Should the digital economy be regulated?

- Algorithmic risks
- Market failures
- Regulatory intervention?
- Competitive Impact
OPTIONS OF ALGORITHMIC GOVERNANCE

Online companies operate at the interface of many laws enforced by different agencies:

- Privacy law
- Data protection
- Transparency law
- Competition law
- Consumer protection
- IPR
FIRST STEPS TOWARDS ALGORITHMIC TRANSPARENCY AND ACCOUNTABILITY

- New FTC Office of Technology Research and Investigation responsible for studying algorithmic transparency
- The European Commission’s Directorate-General for Communications Networks, Content & Technology is calling for comments on a proposal to regulate online platforms.
- EU Commissioner Vestager’s statement advocating for compliance by design with data protection and antitrust laws
- German Chancellor Merkel’s public statement:

  The algorithms must be made public, so that one can inform oneself as an interested citizen on questions like: what influences my behaviour on the internet and that of others? (...) These algorithms, when they are not transparent, can lead to a distortion of our perception, they narrow our breadth of information.
DIFFICULTIES IN ENFORCING ALGORITHMIC TRANSPARENCY AND ACCOUNTABILITY

- Public disclosure of algorithms may reduce incentives for investment and innovation
- Disclosing a complex program code may not suffice as a transparency measure
- Transparency and accountability are challenging when decisions are taken autonomously by the algorithm
- Enforcement cost of reviewing and supervising algorithms

Risk that algorithmic transparency facilitates further algorithmic collusion
FURTHER INFORMATION

THANK YOU FOR YOUR ATTENTION!

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