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# Digital revolution, consolidation and AI -- Implications for competition policy

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# Topics

## 1. Consolidation in online markets

- Does it reduce competition and what to do about it?

## 2. Algorithms and Artificial Intelligence

- Do we need to change the law?

# Topics

## 1. Consolidation in online markets

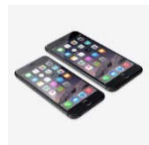
- Does it reduce competition and what to do about it?

## 2. Algorithms and Artificial Intelligence

- Do we need to change the law?

# Online innovation and new business models create huge consumer welfare

- “*The consumer wins: tech makes things easier, less time-consuming, less uncertain, and less costly.*” (BofA Merrill Lynch)
  - Faster innovation, perfect customization, sharing economy, products as a service
  - Free products and services dramatically expand access, choice
  - Instantaneous transactions / access to information
  - Peer-to-peer services substantially reduce cost -- no capital outlay
  - Zero switching costs online
  - Wide scope for user creativity
- But disruption is also painful — privacy? employment? Existential threatsz



But print media,  
politicians, and  
rivals complain  
about the  
ubiquity and  
global power of  
digital firms



Regulating the internet giants

The world's most valuable resource is no longer oil, but data

*The data economy demands a new approach to antitrust rules*

FINANCIAL TIMES

Tech giants need to rein in powers before EU does

11 May 2017

Pressure is growing on Google, Facebook and Apple over their unprecedented influence

# What are the concerns?

Dalia Marin, Bruegel, “Restoring Competition in the Digital Economy”

- “With “superstar” companies operating globally, and dominating markets in multiple countries simultaneously, market concentration throughout the Group of 20 developed and major emerging economies has increased considerably in just the past 15 years. Two forces ... are driving the global decline in labor’s share of total income.
- The first is digital technology itself, which is generally biased toward capital.
  - [Is the proposal to use competition law to slow down digital technology?]
- “The second force is the digital economy’s “winner-takes-most” markets, which give dominant firms excessive power to raise prices without losing many customers.
  - [What evidence? Are many online services not free?]
- “Today’s superstar companies owe their privileged position to digital technology’s network effects, whereby a product becomes even more desirable as more people use it.
  - [Are network effects relevant in all cases? Are efficiencies not more relevant?]
- ...[F]irms that are already established can keep growing with far fewer workers than they would have needed in the past.
  - [Does that not *lower* barriers to entry?]
- “the G20 should create a World Competition Network to restore competition and ... to reverse the decline in labor’s share of GDP.
  - [How could competition law ever achieve that? Do we want measures to prohibit improvements in productivity?]

## Big is Bad?



European parliament votes yes on  
'Google breakup' motion

*The New York Times*

Is It Time to Break Up Google?

*'Let the jury consider  
their verdict,' the King  
said.*

*"No" said the Queen;  
"Sentence first --  
verdict afterwards"*

## What are *really* the concerns? Disruption of society

Vestager TED Talk 2017, “How Competition can restore trust”:

*“[Restriction of competition] can give people a sense that the world isn't fair. They see that the market – which is supposed to serve everyone – becomes more like the private property of a few powerful companies. ... lack of trust in the market can rub off on the society as such - so we lose trust in our society. ...*

*As our societies grow, trust gets more important than ever – and harder to achieve. Especially when new technologies change the way we interact. Those technologies can help us to trust each other, with things like ratings and other systems that have made the sharing economy work. But technology also creates totally new challenges, when it invites us to trust not other people, but computers and algorithms. ...*

*[L]ess than a quarter of Europeans trust online businesses to protect their personal information. But what if people knew they could rely on technology companies to treat them fairly? .... What if they knew that compliance with the rules was built into algorithms by design? ... Together with regulation, competition rules can do that. “*



# How to deal with “fairness” and “trust”?

## First task – Understand what is “consolidation”

- Consolidation = growth of global IT firms that compete with local offline firms.
- This not the same as – and does not necessarily result in – reduction of competition. To the contrary.
- We see intensification of competition, new services, and expansion of output
  - disruption is *increased* competition between **offline and online** suppliers
  - increased **intra-platform** competition.
  - increased **inter-platform** competition between online suppliers at a global level (innovation race and attention rivalry)
    - Different platforms compete for users’ attention, providing free services
    - They also **compete by innovating** and seeking the next greatest thing.
      - This drives, for instance, the fierce competition between Amazon, Apple, Facebook, Google, IBM, Microsoft, Uber and others to create viable AI systems
  - Also: **start-ups and mini-multinationals**,

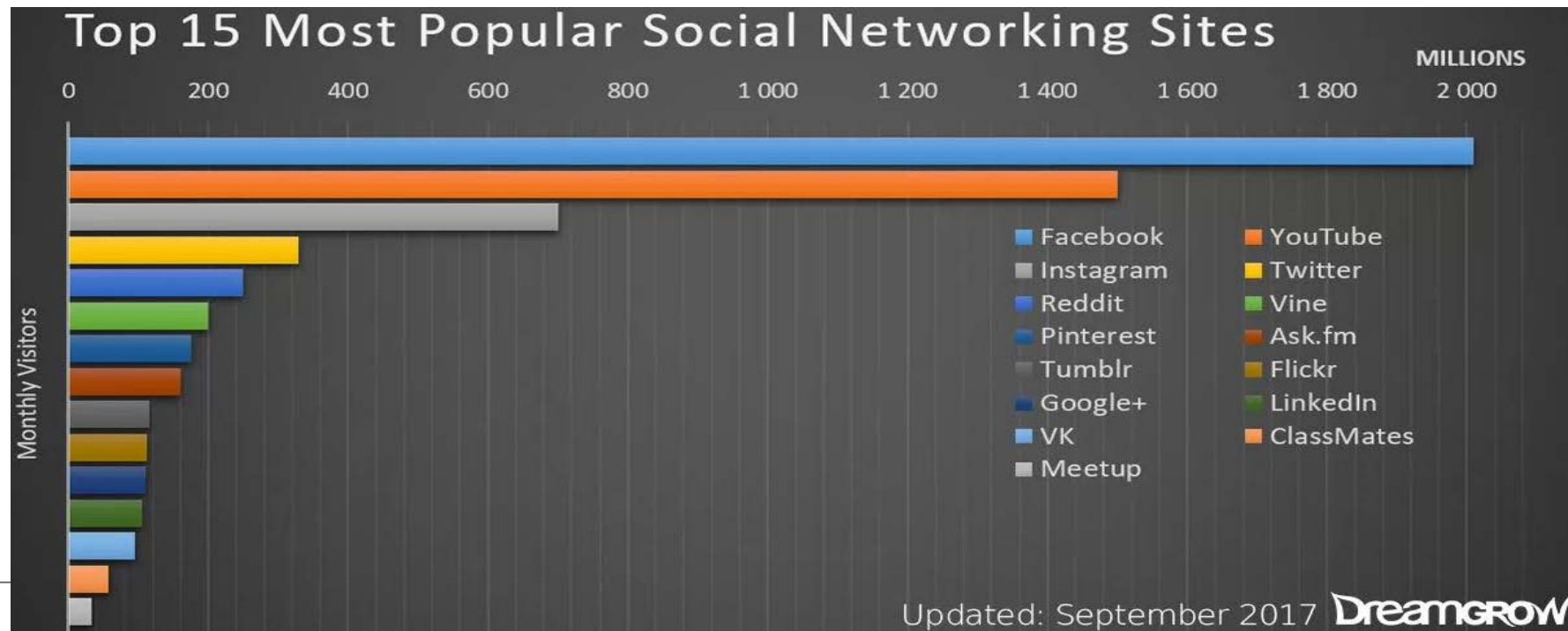
# Consolidation is shift of competition, not restriction of competition

## Example: Proliferation of social networks

- Pete Cashmore, *Feeding the MySpace Beast*, April 2006:

*“Believe me: you can’t build the next MySpace. You may think you can, but you can’t. And don’t go thinking you can win by having more features: social software doesn’t work like that.”*

- But Myspace had too many ads, did not manage the platform well, and did not innovate enough
- Now Facebook took over, but it has to innovate constantly to stay competitive



# UK DBEIS Study: “Dynamic Competition in Online Platforms” – March 2017

- Network effects do not block dynamic competition

“Entry is common and tends to materially affect the market – in most of the markets studied there has been frequent entry with new platforms which materially affect the market share of incumbent platforms”

“Effective entry does not appear to be less likely in more concentrated digital markets – while the social network sector appears to be the most concentrated of those for which we have data, it also saw recent and innovative entry”

“Online platform market shares tend to be fragile, limiting the extraction of material rents – most platforms offer their services to users for free and it seems even platforms with a large market share would lose most of their users if they introduced even a modest user fee.”

“We find that regulatory interventions can affect innovation”

# Another example: Competition between mobile platforms (Apple, Android, Microsoft)

The collage is divided into three vertical panels. The left panel features an iPad and an iPhone displaying the iOS home screen, with the 'Available on the App Store' logo and the Apple logo below. The middle panel shows a Windows 10 Mobile phone with the text 'Windows 10 Mobile', the 'Download from Windows Store' logo, and logos for Acer, HP, Cherry Mobile, Alcatel OneTouch, and Archos. The right panel displays a hand holding a smartphone with the Android Nougat logo, the text 'ANDROID NOUGAT', the Android robot logo, 'Google Mobile Services' with various app icons, the 'Google play' logo, and logos for Samsung, HTC, Sony, Huawei, and LG.

## Competition between platforms does not cease, but shifts

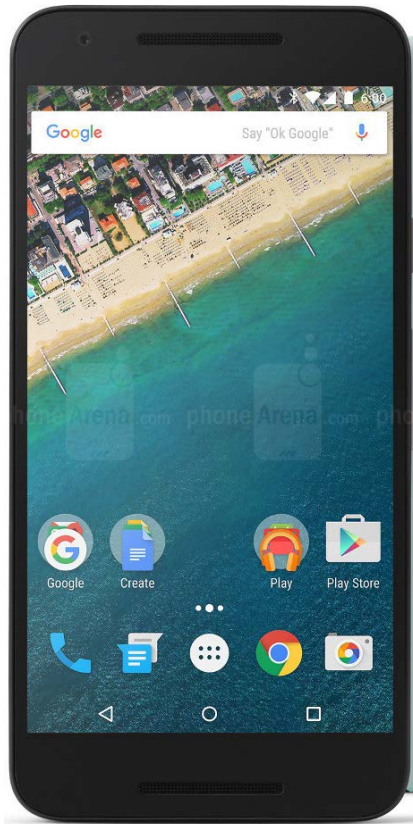
- Android laid the ground for other OSs that compete with Android, iOS, and Windows Phone



- **New form factors** will arise like digital assistants (like Echo), wearables, modular hardware (like gaming), device convergence (two-in-ones, phonepads), VR and 3D, and AI
- Universal apps, cloud-based apps, webapps, superapps



... and competition within platforms, a whole variety of competing flavours and app suites (Android example)



**Google Nexus**  
Android compatible  
with GMS



**Sony**  
Compatible,  
with GMS







**Oppo**  
Compatible,  
without GMS



**Amazon**  
Non-compatible,  
without GMS

## And within each device, competition between a myriad of apps

	> 1 billion downloads each
	> 500 million downloads each
	> 50 million downloads each
	

Android users have installed more than 65 billion apps from Google Play in the last year

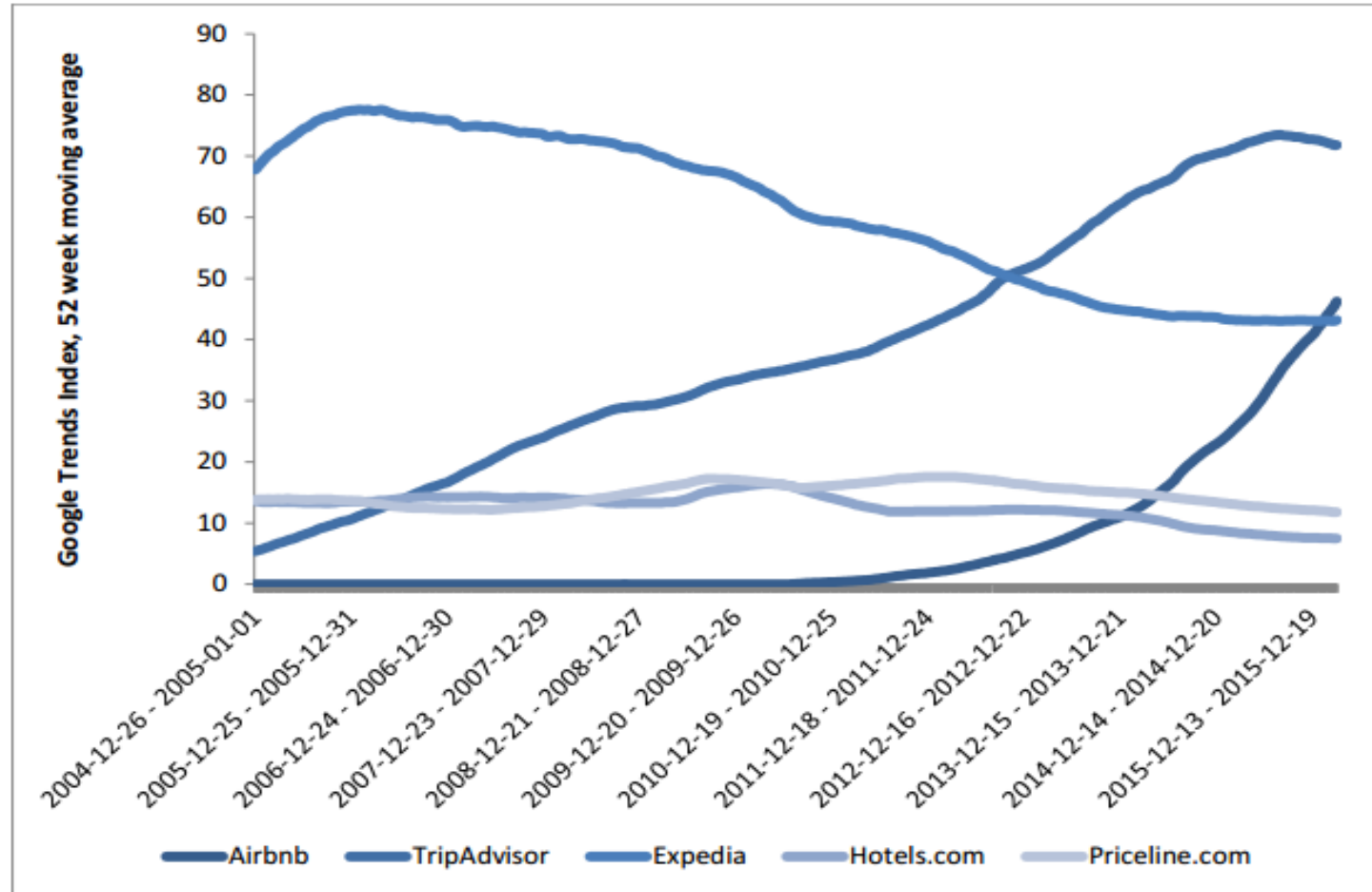
*While 600 new Android phones have launched*

By [Nick Statt](#) on May 18, 2016 02:08 pm [Email](#) [@nickstatt](#)

**THE VERGE**

(with users downloading apps in <20 seconds)

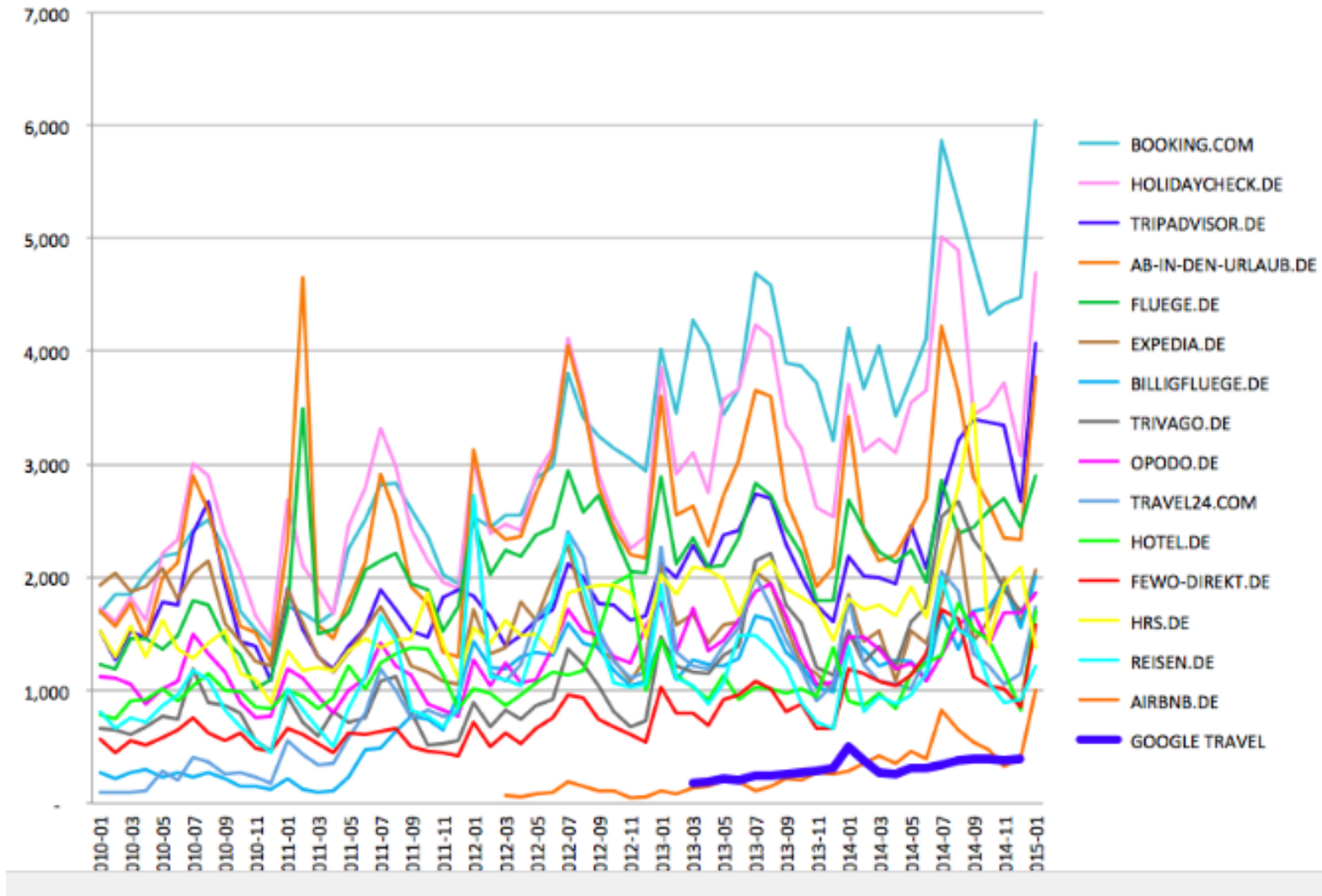
## Within app categories, intense competition. Example: Travel sites -- Significant Shifts in Market Share



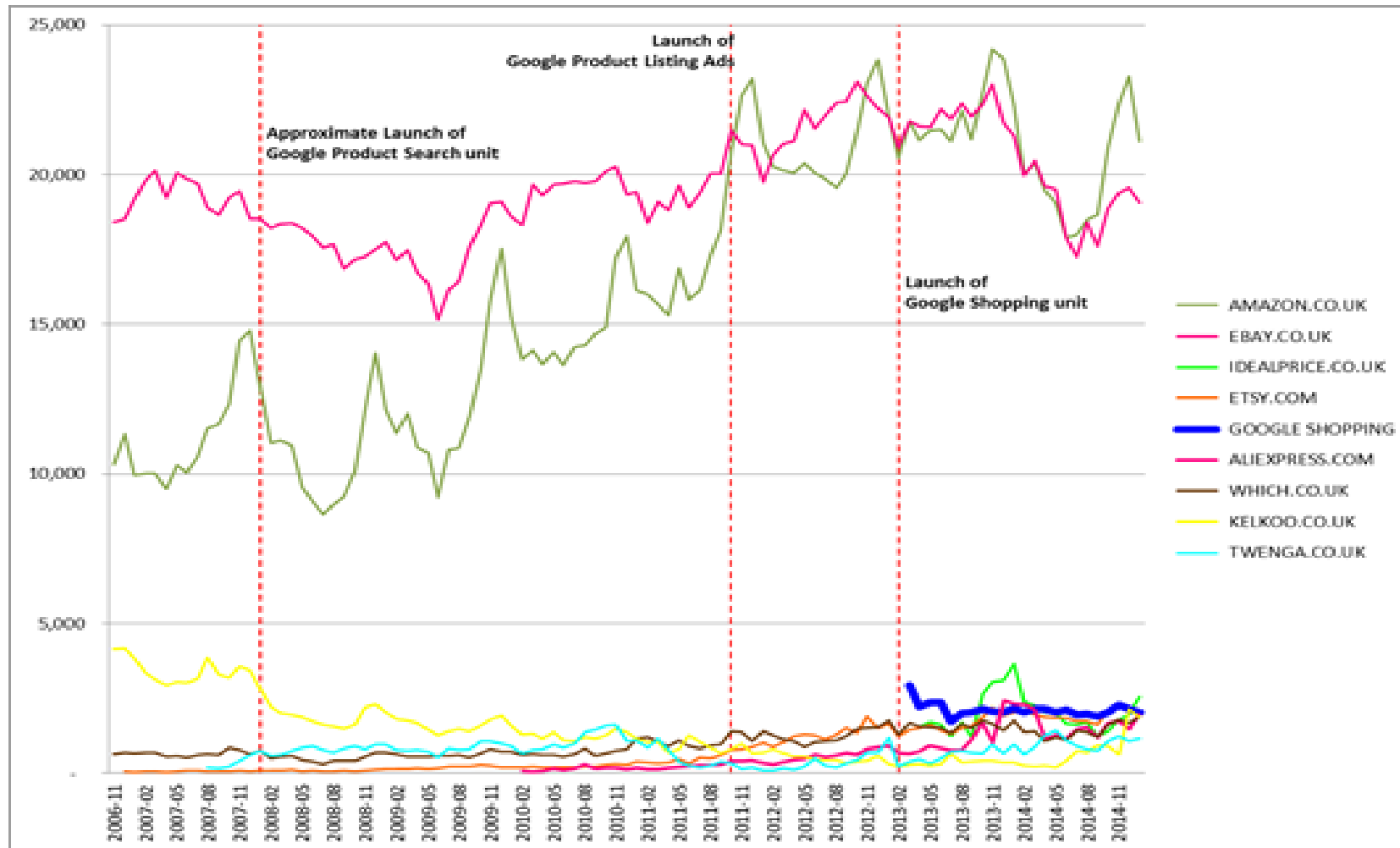
Source: DBEIS Study on Dynamic Competition in Online Platforms, March 2017



# Travel sites in Germany



## More examples: Unique visitors to UK Shopping Search sites (challenge: find the “dominant” one)



# CMA research confirms this competition (and multihoming): “Online search behaviour” – April 2017

*“With the **wealth of search tools available to consumers to access web-based shopping opportunities, it should not be surprising that consumers may use more than one as they search for products and services online**”*

Multihoming and competition between

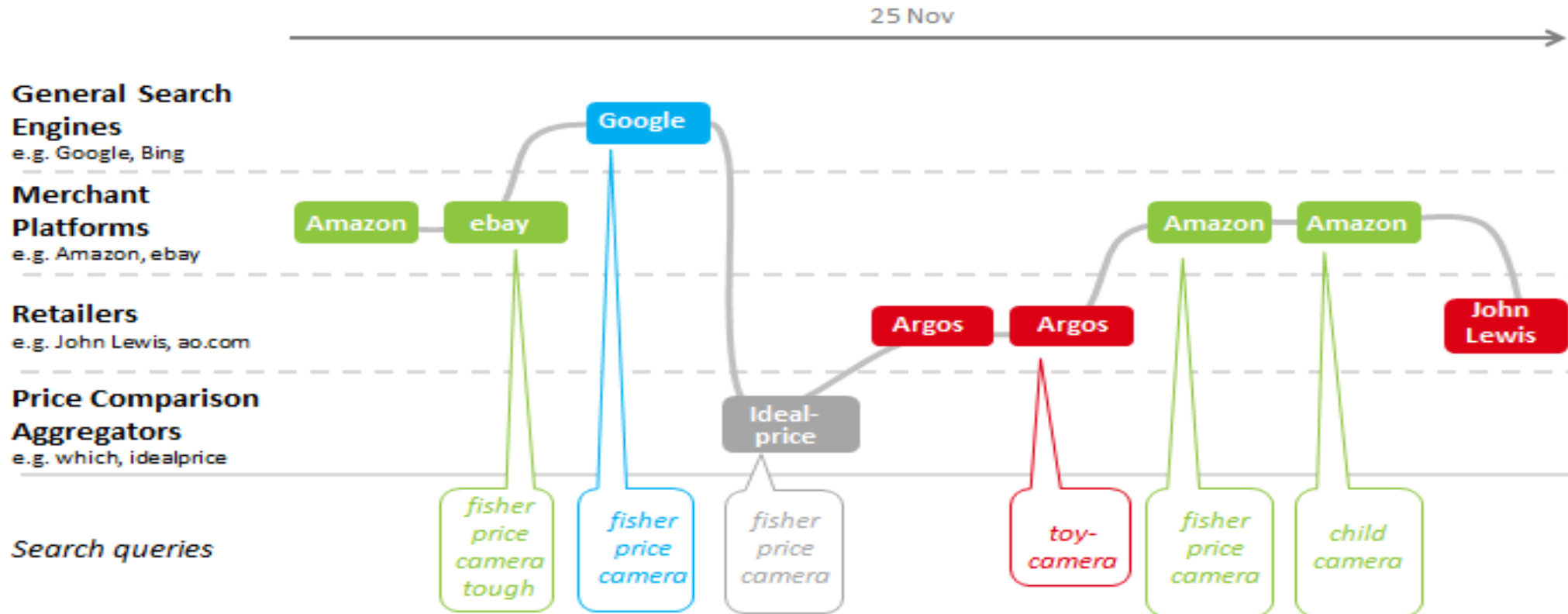
- general search,
- specialized search,
- social search,
- Sites like Wikipedia, etc.
- apps: tablet and smartphone users **tend to go directly to websites and apps more than they use search engines to find information**
- **New form factors, like digital assistants**

*“Search is not where it’s at. ... When people want to find a place to go out to dinner, they’re not searching; ... They’re using apps to get to data on the Internet”* [\(Steve Jobs\)](#)

# User multihoming facilitates switching and new entry

## Depiction of the online consumer journey for an online retailer

### EXAMPLE OF AN INDIVIDUAL SEARCH JOURNEY: CAMERA



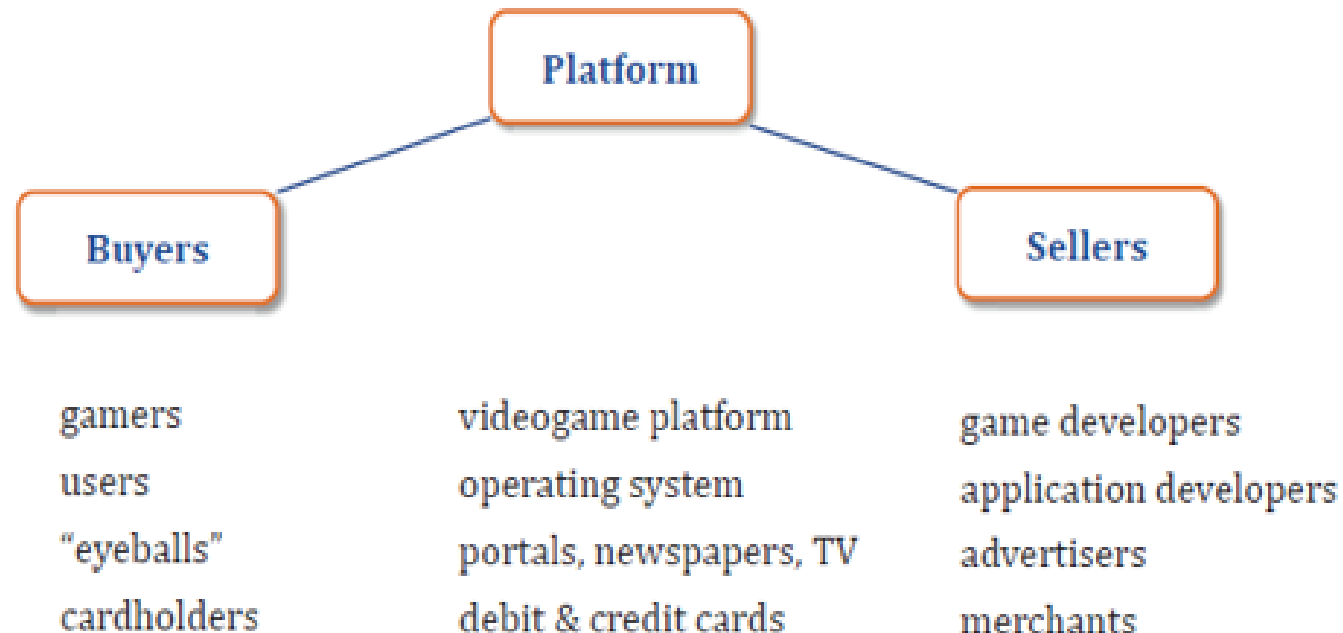
## What drives this competition? Attention rivalry and ad revenue

Platforms bring together economic actors who want to transact

Customers on the two sides are **complements** for producing value

*A market is two-sided if the **platform can affect the volume of transactions** by charging more to one side of the market and reducing the price paid by the other side by an equal amount; in other words, the **pricing structure matters**, and platforms must design it so as to bring both sides on board.*

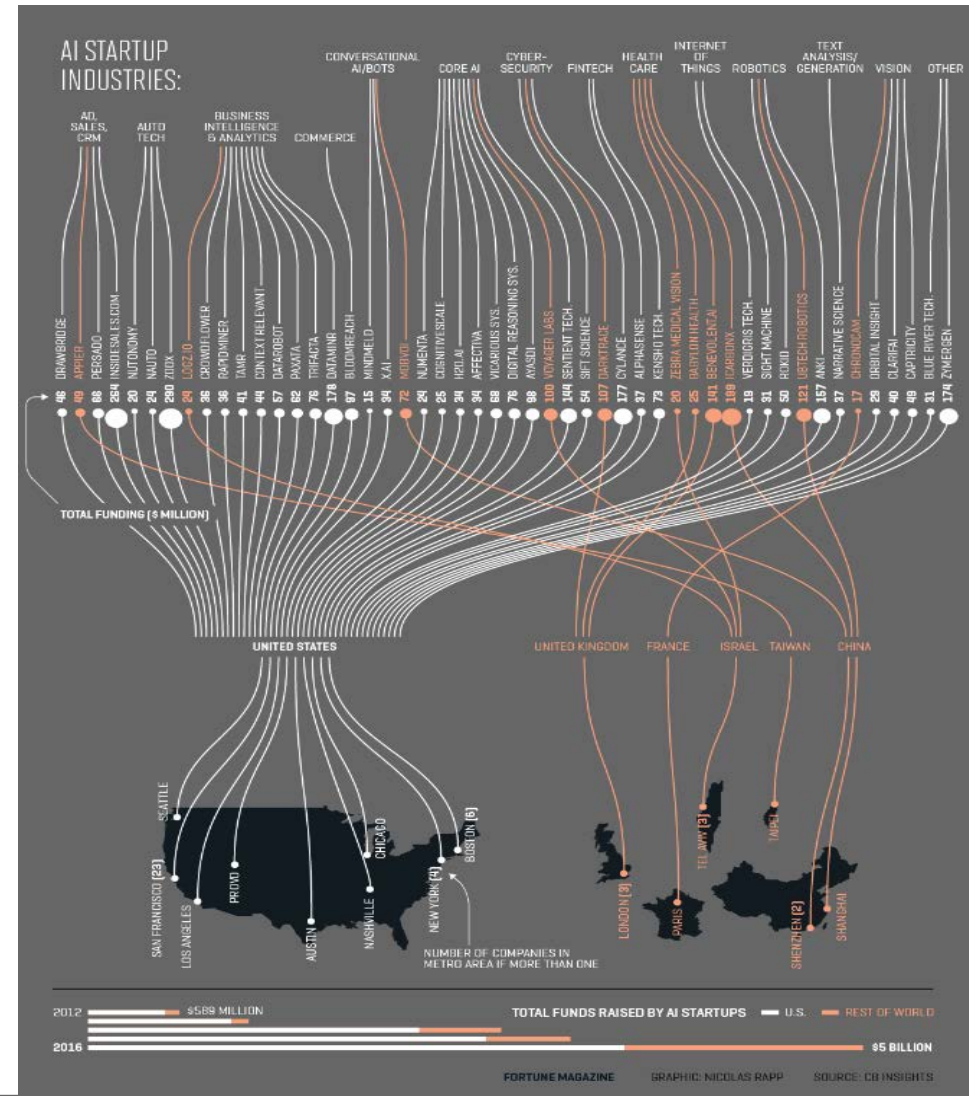
Rochet and Tirole (2006)



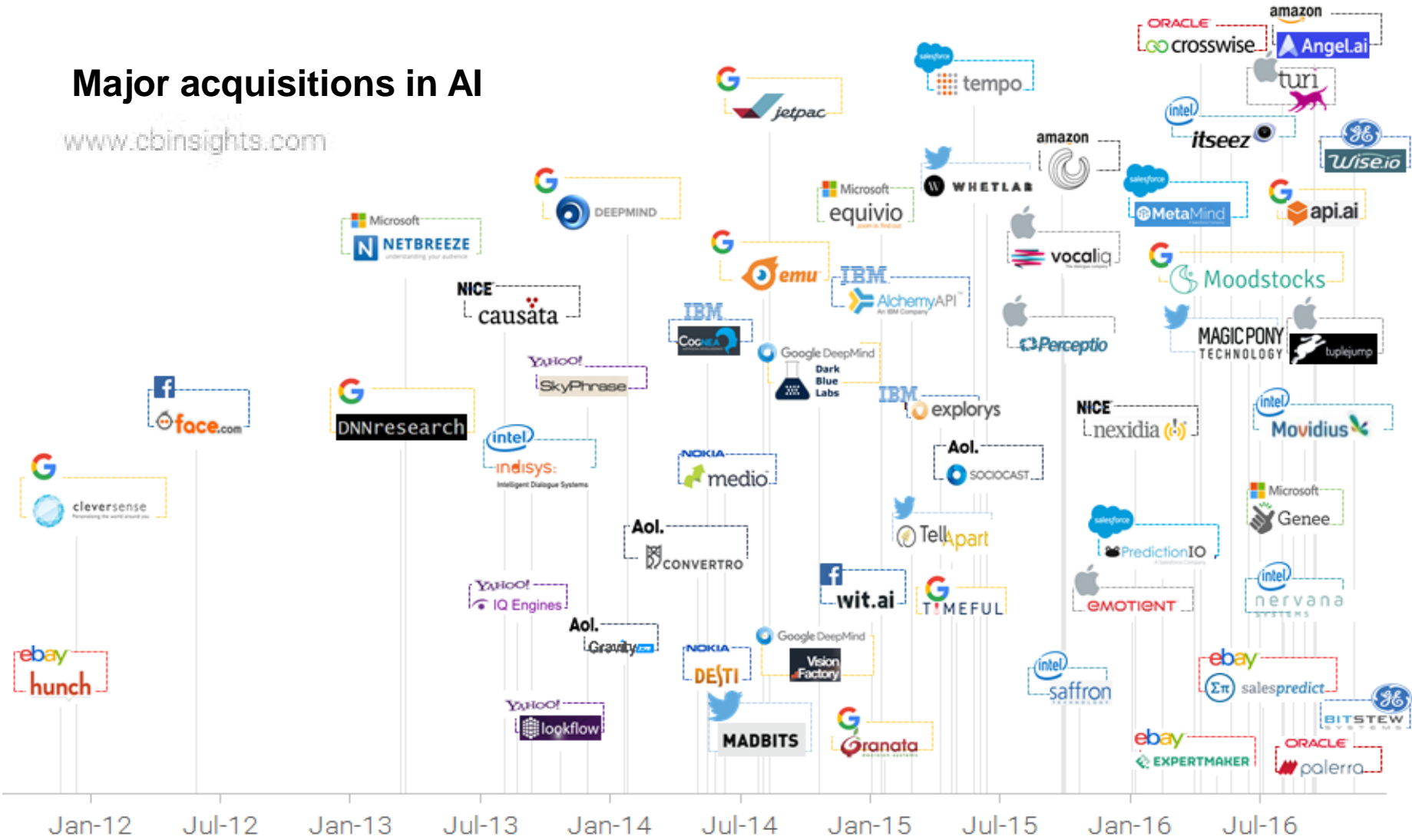
# Also: Competition on Innovation for the next big thing: AI

## ■ 1650+ companies innovating in AI, including:

- Alibaba
- Amazon (Alexa)
- Apple (Emotient, VocallQ)
- Baidu
- Facebook
- Google (Deepmind),
- IBM (Watson)
- Microsoft
- OpenAI
- Salesforce (MetaMind)
- SAP
- Tencent
- Uber (Geometric Intelligence)
- Zalando



# Competition on Innovation for the next big thing drives startups





## Do we see a slowdown of innovation?

- *Entrepreneurship and the Soul of the American Economy*, Dearie and his co-author interviewed more than 200 founders about the challenges of building businesses. Their subjects cited five factors:
  - insufficient access to capital;
  - difficulty finding people with the right skills;
  - immigration policies that keep talent out;
  - onerous taxes and regulations; and
  - economic uncertainty.
- Generational issue: Boomers v Millennials - The Millennials, meanwhile aren't expected to start launching companies en masse for five to seven years. They are being less risk-averse:
- U.S. population growth is shrinking; greying
- Attractive employment
- Other [sources](#) disagree: Entrepreneurship has actually been on the rise since 2011, according to GEM, which surveys individuals and national experts rather than the government data that Kauffman and Brookings rely on. **The rate of nascent entrepreneurship has almost doubled since 2010, from 4.8 to 9.7 percent. (How many of those will result in new companies, though, is anybody's guess.)**



# Conclusion

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- Consolidation = growth of global IT firms that compete with local offline firms.
- Not the same as – and does not necessarily result in – reduced competition.
  - In fact, we see acceleration of innovation and intensification and competition, creating huge consumer welfare
- If restriction of competition is not the problem, then competition law is not the answer
  - Indeed, raising expectations leads to frustration and further loss of trust if and when it turns out competition law cannot address disruption (Google case...)!
- The answer is (a) use of tech developments, and (b) sensitive regulation where needed as a last resort – let's discuss AI as an example

# Topics

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## Background: artificial vs human intelligence

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- Watson, Deepmind, Alexa, digital assistants, AI :
  - Greater intelligence – ability to see trends before humans do
  - Faster processing power; learning ability
  - Flawless access to Big Data (although data can be flawed)
  - **But no evolved sense of ethics, fairness, and compliance**
    - Contrast: human cooperation based on a sense of ethics and fairness evolved over many 1,000s of years, now innate (Ken Binmore, Natural Justice)
    - AIs can reflect and learn flaws and [biases](#) of human behaviour (Microsoft's Tay...)
    - Will humans always remain in control? Experiments so far suggests that the most powerful combination is cooperation between humans and AIs, not AIs alone
- Can AI systems *learn* ethics and cooperation?
  - Robert Axelrod's "[evolution of cooperation](#)" (1984): tit-for-tat expectation or open promises of price matching lead to tacit collusion. AIs can learn that too
  - Hal Varian [Santa Fe double auction](#) experiment: AIs can find optimal strategy

## Current view of AIs trading with each other – trend towards conscious parallelism even absent oligopoly

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*“To the extent that the effects of increased oligopoly fall through cracks of antitrust law, the advent of the robo-seller may widen those cracks into chasms. For several reasons, the roboseller should increase the power of oligopolists to charge supracompetitive prices: the increased accuracy in detecting changes in price, greater speed in pricing response, and reduced irrationality in discount rates all should make the robo-seller a more skillful oligopolist than its human counterpart in competitive intelligence and sales. ... the robo-seller should also enhance the ability of oligopolists to create durable cartels”* -**Salil Mehra, Antitrust and the Robo-Seller: Competition in the Time of Algorithms, 100 Minnesota Law Review 2015**

*“a self-learning machine may find the optimal strategy is to enhance market transparency and thereby sustain conscious parallelism or foster price increases. Importantly, tacit coordination--when executed--is not the fruit of explicit human design but rather the outcome of evolution, self-learning and independent machine execution.”* -**Maurice E. Stucke & Ariel Ezrachi Artificial Intelligence & Collusion: When Computers Inhibit Competition, University of Tennessee College of Law, Research Paper #267, May 2015**

- But **is this correct?** In all cases?

# AI may change conditions that normally curb tacit coordination

## • MARKET CONDITIONS PREVENTING COORDINATION

- Large number of sellers (*i.e.* as the number of sellers increase, the **probability that individual sellers will ignore their rivals** increases as do the odds of getting a maverick.)
- **time lag between initial price cut and response** of rivals (e.g. due to ability to conceal price cut for at least some time, due to delays in retaliation, or due to lack of spare capacity needed for retaliation)
- **High discount rate of future profits** (incentive to appropriate profits today)
- **Misinterpreting shocks to demand or supply** as deviations
- With **different cost structures**, *i.e.*, where overhead costs are high, pricing discipline tends to break down during recessions
- Product **heterogeneity**, *i.e.*, the greater the heterogeneity, the more difficult coordination



## • ASPECTS OF AI ENABLING COORDINATION

- × **AI may facilitate coordination even among large number of sellers**
- × **AI may be able to detect deviations and respond immediately to “cheating”, due to access to big data**
- ✓ **But capacity constraints unaffected**
- × **AI may be programmed to prefer long-term profits**
- × **AI may recognise real cause of price reductions**
- ✓ **AI should have no impact on cost structures, including incentive to discount so as to recover fixed costs by increasing volume but cost data may become accessible**  
AI does not reduce product heterogeneity

# But will oligopolistic pricing always be the outcome?

## Alternative #1: Predatory pricing in commodities

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- If AI is set to maximise long-term profits, are there circumstances in which it will seek to exclude rivals, rather than tacitly collude with rivals?
  - **Incentive:** Competitiveness can be designed into AIs, if programmed to win or to maximize profits. AIs can be [highly aggressive](#) in stress situations !
    - *“when the Google team tested more and more complex forms of DeepMind that sabotage, greed, and aggression set in”*
  - **Ability:** Dominant AI system may realise that [predatory pricing / exclusion are optimum strategy](#) to maximise long-term profits:
    - Big data is vast and may extend beyond price information
    - AI systems may have access to rivals’ market shares, assets, capital reserves, employee count, variable and fixed costs, etc. needed to assess success of predation
    - AI may be able to approximate rivals’ cost curves with greater accuracy

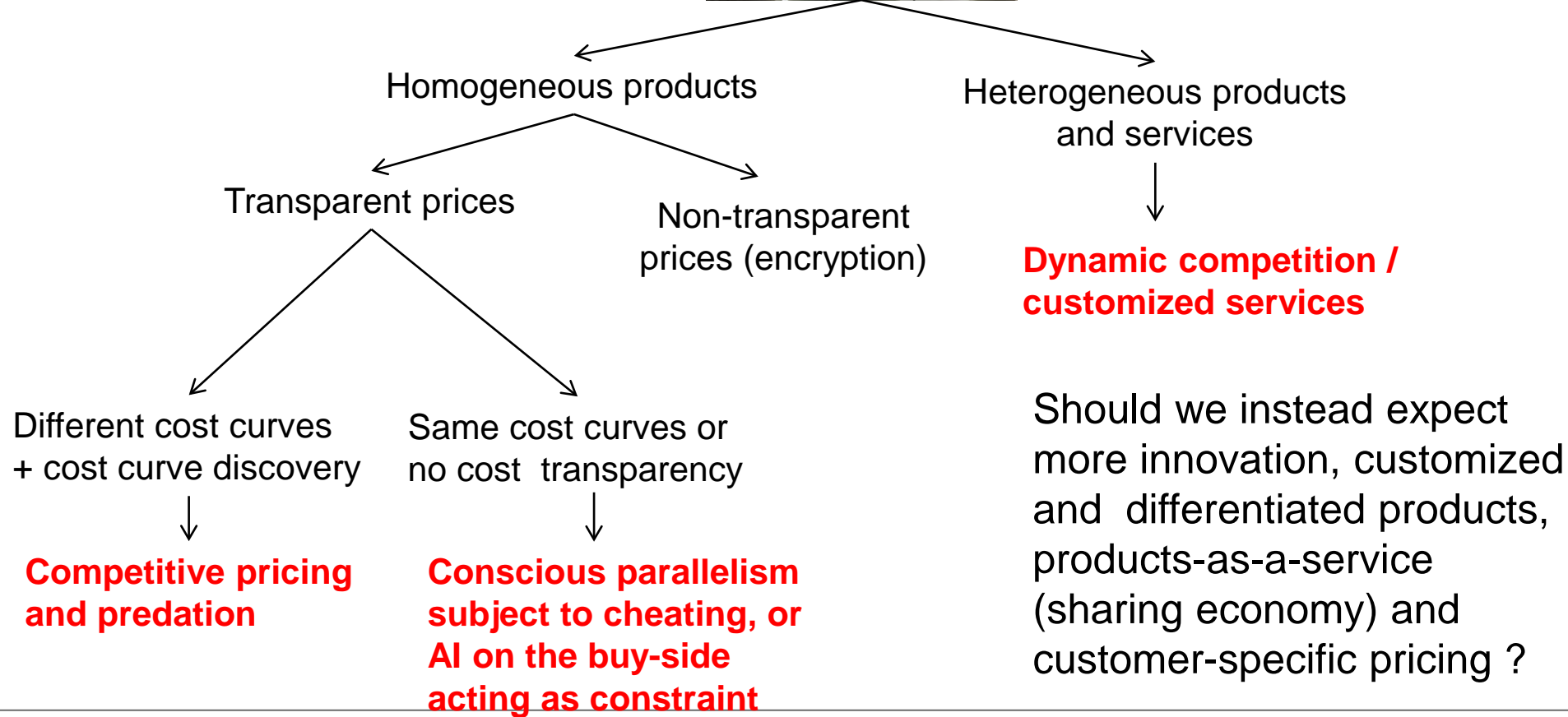
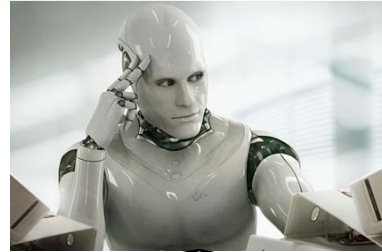
## Alternatives #2 and #3: Competitive pricing; customization?

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- #2: Will access to “big data” really increase price transparency?
  - AI systems may compete intensely on building proprietary databases
  - Price discounts may be offered via encrypted communications direct to customers (via email, mobile apps, etc).
  - AIs are capable of encryption and [deception](#) even in IoT trading
  - Result could be **opaque** pricing information and **competitive pricing**
- #3: Will sellers offer homogenous products? **Or move to customization?**
  - Products are becoming increasingly differentiated, and service-based
  - Technology is being applied to previously commoditised goods
  - Result may be IP-protected, heterogeneous products, offered as a service
  - Hard even for algos to compare “like for like” prices / achieve collusive equilibria

**Result = more innovation, differentiated products, products-as-a-service, competitive pricing and customer-specific pricing?**

# Multiple possible outcomes other than oligopoly pricing





# And if oligopolistic pricing results, can it be countered?

- Buyers (or buy-side AIs) can **use AI to counteract oligopolistic pricing by selling AIs?** Invite or arrange new entry, encrypted communication, etc
- **Art 101 TFEU prohibits** (direct or “hub-and-spoke”) information exchange and price coordination, outsourcing of pricing to common agents, and signaling
  - Obtaining price data via customers or public sources is normally allowed, but not if they act as a “hub” for systemic exchange where suppliers know about and accept exchange
    - *“concerted practice consisting of indirect contact between competitors ... is no different in substance from two competing retailers sitting across a table and telling each other what their prices will be next week”* — CAT in *Tesco*
  - Signalling can also be illegal: public announcement made in advance, without commitment to the price, announced in terms of percentage increase
- Attribution of liability: AI acts on behalf of (is a tool used by) a firm, which is liable for exchange or collusion where it knows and accepts that a rival uses AI systems to get access to its price data and *it itself* uses AI systems get access to rivals’ data, and to set prices on that basis, or allows such AI systems to do so and benefits from it

# The longer-term question

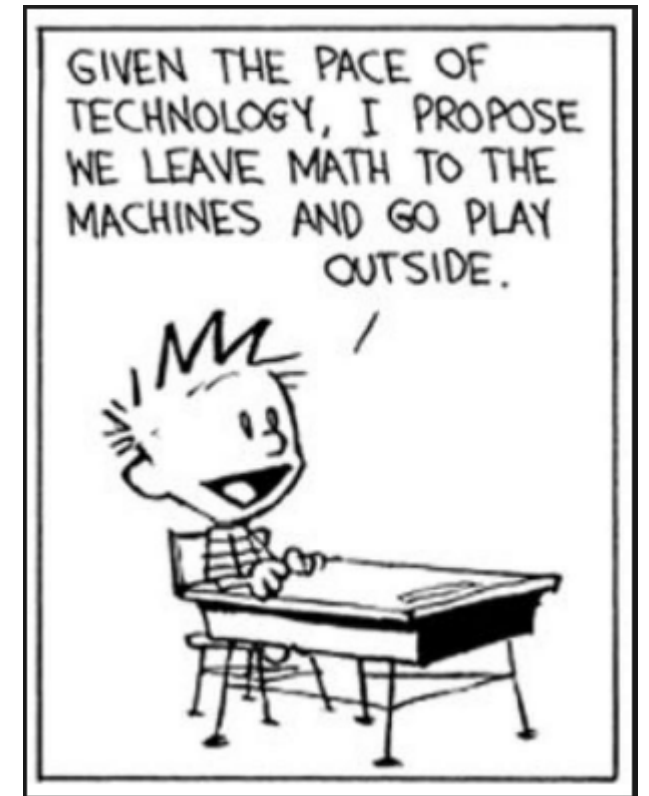
## Compliance by design? A Digital Conscience?

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- Vestager: “[L]ess than a quarter of Europeans trust online businesses to protect their personal information. But what if people knew they could rely on technology companies to treat them fairly? ... What if they knew that compliance with the rules was built into algorithms by design? That those algorithms had to be designed in a way that mean they couldn't form a cartel, for instance? Together with regulation, competition rules can do that.”
- But can AI programs be taught compliance, and learn to comply?
  - AI’s “White Guy problem”
    - Recent research in Science journal on semantics derived automatically from language suggests instructions given to AI can lead to inadvertent discrimination
    - AI reflects designers’ bias (conscious or unconscious) and society’s bias
  - And how can we train AI to identify what we cannot yet see ourselves?

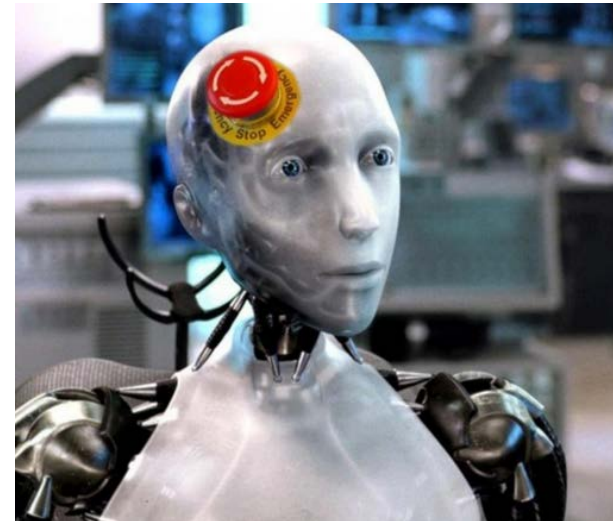
## How would conscience be achieved? Is it technically possible?

- Code is law?
  - Approach taken to the internet, see Lawrence Lessig (1999)
  - Can certain constraints be hardwired into AI, in the same way that train tracks guide trains?
  - Problem: AI learning to adapt and re-write itself
- Teach AI in the same way we would teach a child, or train an animal?
  - Can we use techniques like Machine and Reinforcement Learning to develop morality?
  - And whose morality to use?



## How would conscience be achieved? Is it technically possible?

- Humans must be able to interfere in price setting if AI trading leads to outcome reducing consumer welfare, and if systems learn to overcome these limitations (“**safe interruptibility**”)
- Google Deep Mind is already working on developing a “kill switch”
- Compare to “killer gene” in bio-engineering/ auto-interrupters in HFT
  - *“AIs are unlikely to behave optimally all the time... Now and then it may be necessary for a human operator to press the big red button to prevent the agent from continuing a harmful sequence of actions,”*
  - *“Safe interruptibility can be useful to take control of a robot that is misbehaving and may lead to irreversible consequences, or to take it out of a delicate situation”*
    - L. Orseau (Google Deep Mind) and S. Armstrong (Oxford Univ. Machine Intelligence Research Institute), [Safely Interruptible Agents](#) (2016)



# How would conscience be achieved? Is it legally possible?

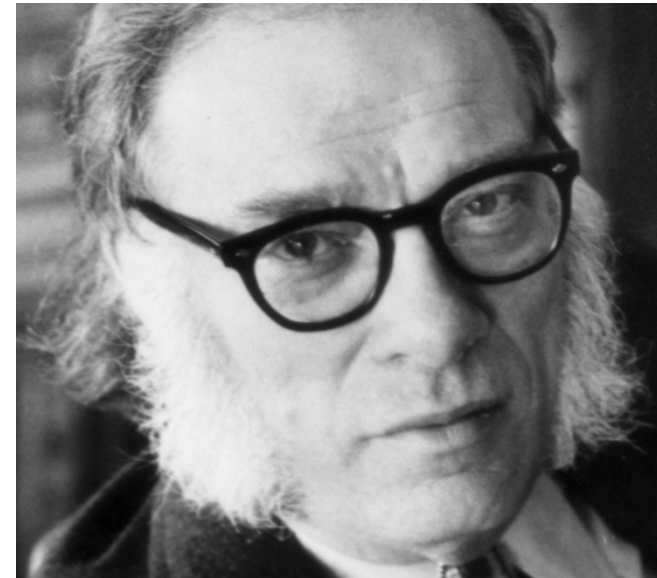
## Historic AI ethics rules

### Asimov's Laws of Robotics (1943):

- I. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
- II. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
- III. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.
- IV. (A robot may not harm humanity, or, by inaction allow humanity to come to harm.)

But...

“These laws are sufficiently ambiguous so that I can write story after story in which something strange happens, in which the robots don't behave properly, in which the robots become positively dangerous.”  
*(Isaac Asimov, interviewed in 1965 on BBC Horizon)*



# A Digital Conscience? Modern examples of AI ethics rules

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- 2017 Asilomar principles
- EU Parliament Resolution of 16 February 2017 on Civil Law Rules on Robotics (including Annex on ethical design)
- A Roadmap for US Robotics (see Chapter 10)
- IEEE initiative on ethics in design of AI systems

**We need experiments, not just “fixed rules”. Initiatives to develop further principles:**

- The Global Initiative on Ethical Autonomous Systems
- GOODAI Virtual School for programmers
- Partnership on AI (joint project of major worldwide tech companies):
- Berkman Klein Center for Internet and Society at Harvard
- The Knight Foundation (partnership with Berkman Klein and MIT Media Lab)

## National? Regional? Worldwide rules for AI?

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Regulation may be needed, world-wide. International regulation sounds difficult... but it has worked in the past for global issues:

- Law of the Sea: UN Convention for the Law of the Sea (1982)
- Space Law: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, AKA "Outer Space Treaty." (1967)
- Medical law: EU Tissues and Cells Directives (2004) introduced common safety and quality standards for human tissues and cells across the European Union

*“The world needs a global treaty on AI, as well as other mechanisms for setting common laws and standards. We should be thinking less about how to survive a robot apocalypse and more about how to live alongside them—and that’s going to require some rules that everyone plays by.”*

- J. Turner, “Elon Musk and Mark Zuckerberg are both wrong about AI and the robot apocalypse,” Quartz, 2 August 2017, (available at <https://qz.com/1044119/elon-musk-and-mark-zuckerbergs-view-on-ai-dont-account-for-which-regulatory-body-will-oversee-our-robot-overlords/>).

And use AI to monitor AI

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1. Do we really see consolidation of dominant positions?

2. What problems do we see and what causes them? Could the market provide a solution?

**3. Conclusion**



# Summary and Conclusion

- **Consolidation is not the same as monopolization.** Global firms may grow and disrupt offline businesses, but this leads to **intense innovation** competition at a global level, **between and within platforms**
- **Competition law is not a panacea** for the bad effects of the globalization and digitalization. **Breaking up firms will not change the causes**, and will just create inefficiencies and reduce consumer welfare
- Instead we should **encourage market- / technology-driven solutions**, which already emerge to deal with social issues such as fake news, loss of privacy, etc., as well as **new ideas to adapt our social economies (like universal income; civics courses teaching internet literacy)**.
- These market- / technology-driven solutions should be studied to determine effectiveness
- Regulation and Government **intervention should be based on evidence**, not ideology, speculation, fear, or fake news.
- Don't underestimate human autonomy and inventiveness, and the ability to **use technology rather than fighting it**.



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