Antitrust and the Internet of Things: Addressing the market tipping fallacy

Aurelien Portuese
a.portuese@itif.org
Director of The Schumpeter Project on Competition Policy (ITIF)
Washington, DC; Adjunct Professor, Global Antitrust Institute, George Mason University; Adjunct Professor, Catholic University of Paris.

1. When Kevin Ashton, a London-based computer scientist at Procter & Gamble, finished his PowerPoint presentation in 1999 to persuade his managers that his company should put radio frequency identification tags and other sensors on products in the supply chain, he needed a title for his presentation. The title would be the "Internet of Things" (IoT), thereby coining a growing and irresistible phenomenon. More than twenty years later, the IoT has become reality. IoT has "smart" possible: Smart cities, smart homes, smart factories, smart farms, smart cities and more. But, although the IoT remains an incipient technology, the artificial intelligence and algorithms embedded in IoT devices have ushered in an array of regulatory concerns. One of these concerns lies in the IoT's effects on competition: Antitrust concerns of the IoT pare down to the emergence of so-called "gatekeepers."

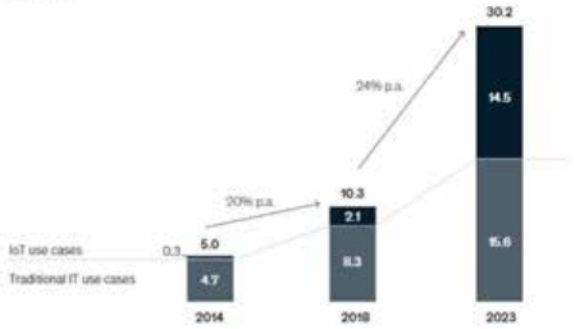
2. This article discusses the fear that the IoT has and will generate gatekeepers. Market tipping, or the extreme concentration of a market by one or few players, remains a basic premise for the designation of gatekeepers. This article demonstrates that the notion of market tipping in IoT confuses the first-mover advantage inherent to "market creation." Absent market tipping or with considerable qualifications, antitrust authorities should reconsider a hasty analysis concluding that IoT markets epitomize gatekeepers.

I. Introduction to IoT

3. The IoT connects the hardware and software products with the Internet: IoT connectivity transforms basic products and functions into "smart devices"—"smart" because these devices act smarter than things that have not been tagged with sensors and connectivity.[1] As a result, Internet-enabled devices (or "smart devices") now represent a considerable part of our daily lives.[2] From smart home products (i.e., smart light bulbs, smart speakers, smart kitchen…) to smart supply chains through smart automation, the IoT transforms physical objects into information ecosystems powered through data processing and connectivity.[3] Now, more than 25% of businesses use IoT technologies. By 2023, the IoT will account for 43 billion connected devices, a threefold increase from 2018, with larger companies and American companies being the early adopters of IoT technologies:[4]

Figure 1.

Revenue pool for device-enablement platforms for IoT and IT, 2014–23,
€ billion



By region	2014	2018	2023
APAC	0.8	1.6	5.3
Americas	2.7	5.5	15.8
EMEA	1.6	3.2	9.1

By company size	2014	2018	2023
Small or home office[1]	0.4	0.8	2.7
Small- and medium-size enterprises[1]	1.0	3.7	9.6
Large enterprises[1]	2.7	5.8	17.8

Source: F. Dahlqvist, M. Patel, A. Rajko, J. Shulman, Growing Opportunities on the Internet of Things, McKinsey & Company (July 2019). Note: small companies: 1–9 employees; SMEs: 10–999 employees; large companies: > 1,000 employees.

1 E. Fleisch, What is the Internet of Things? An Economic Perspective, Auto-ID Labs White Paper, WP-BIZAPP-053 (January 2010), at 3.

2 D. Castro, J. Misra, The Internet of Things (Center for Data Innovation Report, November 2013) (noting at 28 that "*there is a need for policymakers to break away from old ways of thinking about data as something to be tightly controlled, and instead view it as a valuable resource to harness for social good*").

3 R. A. Mouha, Internet of Things (IoT), *Journal of Data Analysis and Information Processing*, Vol. 9. No. 2 (2021): 77–101 (noting at 78 that "[a] *major shift in our daily routines can be observed along with the widespread implementation of IoT devices and technologies. IoT is everywhere, although we don't always see it or know that a device is part of it*"). *See also* D. Castro, J. Misra, *op cit*. note 2.

4 F. Dahlqvist, M. Patel, A. Rajko, J. Shulman, Growing Opportunities on the Internet of Things, McKinsey & Company (July 2019) (noting at 2 that "*technological* [development] *means that IoT technology will become easier to implement, opening the door for a wider variety of companies to benefit from IoT applications*").

4. The economic impact of the IoT cannot be underestimated: It embodies the seeds for disruptive innovations with multiple unknown benefits; IoT technologies represent $14 trillion of value creation in a decade.[5] Moreover, as a "*disrupting manufacturing*," the IoT "*opens up real opportunities for early adopters looking for a competitive edge.*"[6] In addition, IoT increases labor productivity and overall growth, albeit the full potential is yet to be unfolded.[7]

5. This capacity to early adopt IoT technologies and thus create new markets for "smart devices" is a double-edged sword. On the one side, the competitive advantage represents an illustration of the Schumpeterian competition-escape innovation: Disruption enables companies to fiercely compete over basic products by transforming them into smart devices. To be sure, IoT technologies are the result of "*competition and rising customer requirements*" and the need for firms to differentiate with outstanding technologically embedded basic devices.[8] IoT appliances promise a better quality of life, greater (industrial and energy) efficiency, stronger security, and health protection, etc.[9] On the other hand, first-mover advantages may generate concerns from competition authorities given the monopolistic position of the disruptor.

II. Antitrust concerns: Gatekeepers via market tipping

6. Unlike the Internet, IoT technologies do not have a single global standard: Because IoT-connected devices inherently relate to the physical world, each IoT ecosystem or project necessarily accounts for physical properties (such as distance, support material, etc.) and thereby is application-specific.[10] Consequently, most IoT technologies presumably embed closed ecosystems with the lack of IoT interoperable standards.

7. Even though "*the IoT market is at an early stage of development, far from its full potential*," antitrust authorities already share concerns across the Atlantic.[11] The diffusion and adoption of IoT technologies are crucial to spurring economic growth through the widespread use of IoT innovation.[12] Yet, antitrust authorities seem willing to regulate the allegedly emerging "gatekeepers" in the IoT.[13]

8. In Europe, European Commission's Executive Vice-President Margrethe Vestager announced on June 9, 2021, the preliminary results of its competition sector inquiry into markets for consumer IoT-related products. The European antitrust head feared that IoT would lead to emerging gatekeepers in IoT: *"When we launched this sector inquiry, we were concerned that there might be a risk of gatekeepers emerging in this sector. We were worried that they could use their power to harm competition, to the detriment of developing businesses and consumers. From the first results published today, it appears that many in the sector share our concerns.*"[14] Puzzlingly, without mention a single time of "gatekeeper" or "market tipping" in the Preliminary Report, the European Commission thus concludes that there are emerging gatekeepers and that IoT markets tend to tip.[15]

9. Launched on July 16, 2020, the final report of the IoT sector inquiry is expected in the first half of 2022. Nevertheless, the European antitrust authorities' fears of market tipping in the IoT appear to materialize. The main risks identified in 2020 by the European Commission were the emergence of gatekeepers through market tipping due to network effects and scale economies: "*Despite its relatively early stage of development, the sector for consumer IoTs related products and services in the Union, there are indications of company behaviour conducive to structurally distorting competition in and for this sector. In particular, there are indications of contractual and de facto restrictions of data access and interoperability, the emergence of digital ecosystems and gatekeepers, as well as certain forms of self-preferencing and practices linked to the use of proprietary standards that could represent barriers to entry and innovation, and could lead to restrictions of market access for competitors, thereby restricting and/or distorting competition in the sector.*"[16]

10. Without further justification, the sector inquiry primarily focused on "*consumer IoTs related products and services*" (i.e., those used by end users) with a specific focus on "*smart home devices*." Such narrow focus precludes the Preliminary Report and the expected report to have a

5 J. Bradley, J. Barbier, D. Handler, Embracing the Internet of Everything To Capture Your Share of $14.4 Trillion, Cisco White Paper (2013).

6 Genpact, Making the IIOT promise real, White Paper (2018), at 1.

7 H. Espinoza, G. Kling, F. McGroarty, M. O'Mahony, X. Ziouvelou, Estimating the impact of the Internet of Things on productivity in Europe, *Heliyon*, Vol. 6, Issue 5 (2020).

8 M. Ehret, J. Wirtz, Unlocking Value From Machines: Business Models and the Industrial Internet of Things, *Journal of Marketing Management*, Vol. 33, Issue 1-2 (2017): 111–130.

9 H. Espinoza, et al., *op. cit.* note 7.

10 E. Fleisch, *op. cit.* note 1, at 7.

11 H. Espinoza, *op. cit.* note 7.

12 N. Côrte-Real, P. Ruivo, T. Oliveira, Leveraging internet of things and big data analytics initiatives in European and American firms: Is data quality a way to extract business value?, *Information & Management*, Vol. 57, Issue 1 (2020), at 3.

13 In Europe, the notion of gatekeeper came to regulatory existence with the proposal of the Digital Markets Act. For an analysis of the proposal, *see* A. Portuese, The Digital Markets Act: European Precautionary Antitrust (ITIF Report, May 2021) (where at 14–21 we question the notion of market tipping as being instrumental to the designation of gatekeepers).

14 European Commission, Press release IP/21/2884 of 9 June 2021, Antitrust: Commission publishes initial findings of consumer Internet of Things sector inquiry.

15 European Commission, Preliminary Report – Sector Inquiry Into Consumer Internet of Things, Commission Staff Working Document, SWD(2021) 144 final, June 9, 2021.

16 Commission Decision of 16 July 2020 initiating an inquiry into the sector for consumer Internet of Things related products and services pursuant to Article 17 of Council Regulation (EC). No 1/2003, HT.5752, C (2020) 4754 final, para. 5. *See also* European Commission, Press release IP/20/1326 of 16 July 2020, Antitrust: Commission launches sector inquiry into the consumer Internet of Things (IoT).

comprehensive perspective of the competitive constraints and market players operating in the IoT (Business-to-Business and Business-to-Consumers included).[17]

11. Because the network effects and the scale of data collected matter to develop a viable competitive strategy, IoT market players focus on data collection before "smartly" processing them. Otherwise, artificial intelligence embedded in IoT devices proves ineffective. However, the European Commission seems to perceive these first-mover advantages over IoT devices as a potential distortion of the "*competitive structures*."[18]

12. The preliminary report reaches the desired conclusions: Although acknowledging that the Sector Inquiry "*includes only a portion of the EU consumer IoT sector*" (excluding B-to-C IoT notwithstanding), the European Commission focuses its "*main features of competition*" of IoT on the niche market for customer voice assistants.[19] In this market where digital companies such as Amazon, Google, Samsung, and Apple have been first movers, the European Commission notes that "*respondents find it unlikely that there would be new entrants in the market for general-purpose voice assistants in the short term, given that the costs of developing and operating new general-purpose voice assistants are seen as prohibitively high.*"[20] To obliterate the medium- / long-term and to consider that high investment costs make improbable a rival capable of competing with Amazon, Google, Samsung and Apple suggest that the competition analysis conveniently rejects a dynamic approach with a longer-term analysis encompassing potential competition from powerful actors (such as Microsoft, Oracle, Samsung, etc.).[21] Also, it rejects any competitive constraint and potential entry by some of the most prominent IoT companies in the world.[22] It ultimately ignores the vast benefits to consumers from market share and network effects.

13. To be sure, voice assistant technologies may raise privacy concerns.[23] They may even lead to lawsuits such as the recently announced lawsuit against Google's Voice Assistant in a federal court in California.[24] But these concerns are not antitrust concerns: Dominant and non-dominant companies should be subject to the same privacy regulatory standards, and enforcement of such standards should not be conditional to the exercise of market power.

14. Interestingly, the Preliminary Report overlooks Amazon's effort to build an alliance to foster interoperability in the voice assistant market.[25] The European Commission should encourage concrete steps such as Amazon's efforts. The Preliminary Report acknowledges the coming launch of "Project Connected Home over IP"—an interoperability alliance between Amazon, Apple, Google, and the Connectivity Standards Alliance (formerly Zigbee Alliance, which includes notably Ikea, Samsung, Philips) for a unified, open-source smart home platform.[26] A unified smart home standard protocol is currently under development: "Matter" would ensure seamless interoperability among smart device manufacturers.[27] Thanks to standardization, the IoT smart devices would then be more easily interoperable whenever they related to the products and services covered by the project. And yet, the European Commission fails to draw the necessary implications from these projects.

15. The Preliminary Report acknowledges that IoT smart devices rely on a mixture of open ecosystems (i.e., open standards or open-source IoT technologies) and closed ecosystems (i.e., proprietary technologies, either licensable or not licensable to third parties).[28] However, the Preliminary Report fails to infer the necessary implications for antitrust purposes of such distinction. For example, do interoperability requirements matter more in

---

17 Ibid. at para. 2 where "*smart home devices*" are "*to be understood as devices used by consumers that are connected to a network and used in the smart home context, such as fridges, washing machines, smart TVs, smart speakers and lighting systems*".

18 Ibid., paras. 3–4 where the Commission considers that "[a]*ccess to these data may be an important contributing factor to market power both in the sector for consumer IoTs related products and services, and the competitive structures thereof* (. . .) *Data is a key input in the development of artificial intelligence and companies having access to this input are likely to be better positioned to compete in markets where artificial intelligence is important.*"

19 European Commission, *op. cit.* note 15.

20 Ibid., at 7.

21 The competition of voice assistants appears more complex than the Sector Inquiry suggests by focusing only on Amazon, Google, and Apple. *See* S. Chaney, 7 Siri Alternatives for Android: Google Assistant, Hound, Alexa and More, Makeuseof.com, April 30, 2021, https://www.makeuseof.com/tag/7-siri-alternatives-android-google-now-cortana (last accessed on July 1, 2021). Equally, the competition for smart speakers already includes numerous brands. *See* P. Hall, J. Van Camp, The Best Smart Speakers With Alexa, Google Assistant, and Siri, *Wired*, April 11, 2021, https://www.wired.com/story/best-smart-speakers (last accessed on July 1, 2021).

22 For a list of the most important IoT companies, *see* https://www.softwaretestinghelp.com/top-iot-companies/#List_of_Best_Internet_Of_Things_Companies (last accessed on July 1, 2021).

23 *See FTC v. TRENDnet Inc.*, C-4426, 122 3090 (2014) (surveillance in the home of unauthorized viewers).

24 J. Stempel, S. Merken, Google must face Voice Assistant privacy lawsuit – U.S. judge, Reuters, July 2, 2021, https://www.reuters.com/technology/google-must-face-voice-assistant-privacy-lawsuit-us-judge-2021-07-02 (last accessed July 2, 2021). *See also* M. Day, Amazon to Let Customers Sue After Thousands of Alexa Complaints, Bloomberg, June 1, 2021, https://www.bloomberg.com/news/articles/2021-06-01/amazon-to-let-customers-sue-after-thousands-of-alexa-complaints (last accessed July 2, 2021); S. Perez, Spotify stays quiet about launch of its voice command 'Hey Spotify' on mobile, Techcrunch.com, April 7, 2021, https://techcrunch.com/2021/04/07/spotify-stays-quiet-about-launch-of-its-voice-command-hey-spotify-on-mobile (last accessed July 2, 2021). Any company using voice recognition can be sued, as illustrated with the recent McDonald's lawsuit in Illinois. *See* J. Maze, McDonald's Faces Lawsuit Over Its Voice Recognition Technology, Restaurant Business, June 7, 2021 (last accessed July 2, 2021).

25 T. Lyles, A year later, Amazon's voice assistant alliance still hasn't attracted any of its rivals, *The Verge*, September 9, 2020, https://www.theverge.com/2020/9/9/21429893/amazon-voice-interoperability-initiative-alexa-apple-google-samsung (last accessed on July 1, 2021).

26 European Commission, Preliminary Report, *op. cit.* note 15, at 68. *See also* C. Gartenberg, Amazon, Apple, and Google's open-source smart home standard is on track for a 2021 launch, *The Verge*, September 8, 2020, https://www.theverge.com/2020/9/8/21427139/amazon-apple-google-zigbee-alliance-open-source-smart-home-standard-2021-launch (last accessed on July 1, 2021). The project is available at: https://zigbeealliance.org/news_and_articles/project-development-to-reality (last access on July 1, 2021).

27 B. Bhushan, This unified smart home standard will matter, Slashgear.com, June 27, 2021, https://www.slashgear.com/this-unified-smart-home-standard-will-matter-27680090 (last accessed on July 1, 2021). The project description is available here: https://buildwithmatter.com.

28 European Commission, Preliminary Report, *op. cit.* note 15, at 74.

closed ecosystems? Do competition concerns bear more relevance in closed ecosystems? Also, what are the prospects for mutually agreed interoperability? For, smart device manufacturers and IoT service providers can improve interoperability through alliances, not necessarily by forced interoperability which would presumably raise consumer prices.

16. As Michael Porter and James Heppelmann write, "*closed systems create competitive advantage by allowing a company to control and optimize the design of all parts of the system relative to one another.* (. . .) *A closed approach requires significant investment and works best when a single manufacturer has a dominant position in the industry that can be leveraged to control the supply of all parts of the smart, connected product system.*"[29] On the contrary, open systems should seldom generate antitrust concerns. This begs the following legal question for competition authorities: Given the tendency of IoT technologies to operate within closed ecosystems, and given the newness of these devices, is there a risk that few companies quickly become gatekeepers in the IoT due to their ability to tip these nascent markets? In other words, do the antitrust concerns about gatekeeping companies in digital services susceptible to materialize for IoT smart devices?

17. This question relates to the extent of possible standardization as this would preclude gatekeeping positions. It is clear from the report that standardization is not the panacea and should only be sought when proprietary solutions or open-source solutions cannot solve "*customer, business, and technical problems more effectively and more cost-efficiently*."[30] Rather than inferring the adequate antitrust implications from its observations, the Preliminary Report conveniently excludes Samsung's market position as voice assistant providers and thus considers that: "*In practice, consumer IoT products and services are generally centred on a few proprietary consumer IoT technology platforms, namely Amazon's, Apple's, and Google's voice assistants and/or smart device operating systems. The majority of respondents consider that leading technology platforms hold bottleneck positions in the consumer IoT sector.*"[31]

18. The "bottleneck positions" clearly refers to a gatekeeper status: The explicitly mentioned companies allegedly have tipped the market for voice assistants and are emerging gatekeepers in the "consumer IoT technology platforms" market.[32] In other words, market leaders and innovators benefit from the winner-take-most phenomenon due to network effects and scale economies. This bears a negative connotation in the Preliminary Report when the European Commission writes: "*Overall, respondents express the view that, whether via standardisation or independent alliances, major technology companies mostly take the lead and impose their own technology solutions.*"[33]

19. Does market builders/leaders necessarily suggest that innovators are gatekeepers? With respect to voice assistants only, companies such as Amazon, Apple, and Google (Samsung and Microsoft excluded) may "*have an unfair advantage to competitors as they could gather more insights about consumers*."[34] Regarding first movers, this is equivalent to reproach innovators to reach end users before non-innovative rivals.

20. In the United States, the antitrust implications of the IoT emerged in 2013 when the Federal Trade Commission organized a workshop dedicated to IoT.[35] In addition, a recently introduced bill—the "IoT Readiness Act"—would require the Federal Communications Commission (FCC) to collect data on IoT growth that depend on 5G networks.[36] Recently, the congressional hearing dedicated its discussion to the antitrust implications of IoT smart home devices.[37] During this hearing, the main antitrust concern expressed by the European Commission surfaced: Emerging gatekeepers are "poised" to be dominant players in smart home devices, especially for voice assistants.[38]

21. As in the European Union, the congressional hearing focused on voice assistants and the role of well-known platforms such as Amazon, Google, and Apple in this market. Unduly inferring from this niche market, the congressional hearing concluded that these platforms become emerging gatekeepers in the IoT market. Overall, there is a shared transatlantic belief that the two or three gatekeepers dominate the IoT because smart home devices, especially the narrow focus of voice assistant devices, feature a handful of companies. However, not only is such focus excessively narrow to infer conclusions about the state of competition in IoT sensors and ecosystems at large, but it most importantly obliterates the necessary distinction between the legitimate concern

29 M. E. Porter, J. E. Heppelmann, How Smart, Connected Products Are Transforming Competition, *Harvard Business Review*, November 2014, https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition (last accessed July 1, 2021).

30 European Commission, *op. cit.* note 15, at 77.

31 Ibid., at 62.

32 "Bottleneck" seems to refer to being an intermediary. *See* European Commission, Digital Markets Act: Ensuring Fair and open digital markets, Questions and answers, December 15, 2020, https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_2349 (last accessed July 1, 2021) (where the European Commission describes gatekeepers as these companies who have "*the power to act as private rule-makers and to function as bottlenecks between business and consumers*").

33 European Commission, *op. cit.* note 15, at 107.

34 E. Johansson, Tech giants are harming IoT competition, says EU, *Verdict*, June 10, 2021, https://www.verdict.co.uk/tech-giants-are-harming-iot-competition-says-eu/ (last accessed on July 1, 2021).

35 Federal Trade Commission, Internet of Things – Privacy & Security in a Connected World Workshop, November 12, 2013, https://www.ftc.gov/news-events/audio-video/video/internet-things-privacy-security-connected-world-workshop-part-1 (last accessed on July 1, 2021). *See* G. G. Wrobel, Connecting Antitrust Standards to the Internet of Things, *Antitrust*, Vol. 29, No. 1 (2014): 62–70 (noting at 64 that "[o]*pen-source standards and business models for IoT products are less likely to create antitrust risks compared to proprietary models*").

36 H.R. 981 – 117th Congress (February 11, 2021).

37 U.S. Senate, Protecting Competition and Innovation in Home Technologies, Subcommittee on Competition Policy, Antitrust, and Consumer Rights, Hearing on June 15, 2021, https://www.judiciary.senate.gov/meetings/protecting-competition-and-innovation-in-home-technologies (last accessed on July 1, 2021).

38 Introductory remarks by Sen. Klobuchar, *ibid.*

for extreme market concentration (i.e., "gatekeepers") and the legitimate motive of innovators creating new markets (i.e., thereby reaping off temporary first-mover advantages).

III. Antitrust reality: Market power via market creation

22. Entrepreneurs explore and exploit the business opportunities ushered by IoT disruptive innovation. They create new products and services which are markets of their own. In that regard, market creation inherently leads to first-mover advantages when entrepreneurs are successful and meet consumer demand. Nevertheless, as innovation would spread and correspondingly entrepreneurial rents would decline, markets will mature after an initial stage of incipiency.[39]

23. Consequently, antitrust authorities should not confuse market-creating with market tipping: The flawed notion of "emerging gatekeepers" may thwart the innovative incentives of disruptive entrepreneurs.

24. When creating new markets (i.e., new smart devices and connected services), an entrepreneur using IoT technologies may very well epitomize the Schumpeterian notion of value appropriation, especially when technologies are at a stage of incipiency: "*Practically any investment entails, as a necessary complement of entrepreneurial action, certain safeguarding activities such as insuring or hedging. Long-range investing under rapidly changing conditions, especially under conditions that change or may change at any moment under the impact of new commodities and new technologies, is like shooting at a target that is not only indistinct but moving—and moving jerkily at that. Hence it becomes necessary to resort to such protecting devices as patents or temporary secrecy of processes or, in some cases, long-period contracts secured in advance.*"[40]

25. The IoT technologies should indeed force us to recognize the need for a dynamic approach to competition as such approach "*causes tension between intellectual property and antitrust paradox to soften. The patent system provides some amount of exclusion; and some amount of exclusion is required to foster innovation, particularly in a more competitive market environment*."[41] A dynamic view of IoT competition would reconcile interoperability/standardization expectations with the necessary exercise of market power by first movers as an incentive and reward to innovations.

26. Innovative companies that created smart devices have inevitably enjoyed first-mover advantages. For instance, when Google, Amazon, Samsung, Sonos, and Apple created their voice assistants and smart speakers, they did not coordinate. As a consequence, standard protocols emerged without interoperability at first, before joint initiatives could foster interoperability. They are market creators rather than gatekeepers: The market evolution may lead to new entrants as innovations become widespread and the market matures. Regardless, it is hasty to conclude that the market has tipped as it is an incipient market.

27. In other words, the attempt in the U.S. to revive the Clayton Act's incipiency doctrine with legislative bills and radical changes in enforcement doctrine to prevent harm to competition before that harm materializes as well as the desire in the European Union to resort to the notion of "emerging gatekeepers" to implement a precautionary approach to antitrust may prove misguided when it comes to market players creating markets via IoT technologies. Indeed, since these markets are merely emerging, any desire to castigate innovators as gatekeepers to enforce essential facilities doctrines to their inventions and patented products would deter innovation and harm competition.

28. Also, a somber analysis of the effects of interoperability warrants caution. Interoperability among IoT devices may generate similar effects to interoperability in digital services. Thus, increased interoperability (i.e., decreased consumer switching costs) may increase, rather than decrease, market concentration under high network effects.[42] Only a viable outside option, such as an equally efficient service or platform, may decrease switching costs and not generate increased market concentration.[43] Decreasing switching costs on one side of the platform (e.g., consumers) may increase the price on the other side of the platform (e.g., service providers), thereby generating net negative effects on economic efficiency.[44] Therefore, increased interoperability and the associated end user's ability to multi-home do not necessarily generate economic efficiencies as cooperation and competition between ecosystems are beneficial.[45] Concerning IoT technologies, what are the implications?

29. IoT smart devices often operate in closed systems since proprietary business models maximize value appropriation and incentivize investments. Closed IoT systems are most present for dominant companies able to produce smart devices within that ecosystem. As a result, closed IoT systems generate the most serious antitrust concerns as opposed to open-source standards. However, there is

39 *See*, more generally, R. Kester, Demystifying the Internet of Things: Industry Impact, Standardization Problems, and Legal Considerations, *Elon Law Review*, Vol. 8, No. 1 (2016): 205–227.

40 J. Schumpeter, *Capitalism, Socialism and Democracy* (New York: Harper & Brothers, 1942 (2008)), at 88.

41 D. J. Teece, *Dynamic Capabilities & Strategic Management: Organizing for Innovation and Growth* (Oxford: Oxford University Press, 2009), at 257.

42 J. Chen, How Do Switching Costs Affect Market Concentration and Prices in Network Industries? *Journal of Industrial Economics*, Vol. 64, Issue 2 (2016): 226–254.

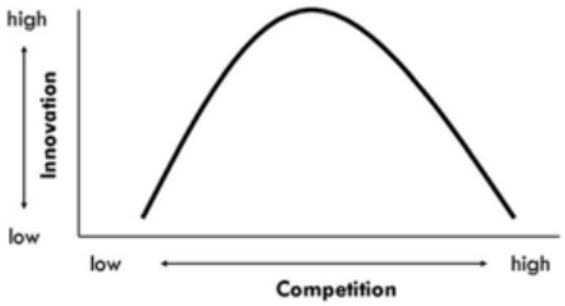
43 Ibid.

44 W. M. W. Lam, Switching Costs in Two-Sided Markets, *Journal of Industrial Economics*, Vol. 65, Issue 1 (2017): 136–182.

45 A. Basaure, H. Suomi, H. Hämmäinen, Transaction vs. switching costs—Comparison of three mechanisms for mobile markets, *Telecommunications Policy*, Vol. 40, Issue 6 (2016): 545–566.

a tradeoff between maximizing incentives of innovators through entrepreneurial rents of closed systems and, on the other hand, fostering entry with open standards with less value appropriation and lower rewards for innovators. Consequently, an optimal level of interoperability (i.e., inter-brand competition) is desirable:

Figure 2



30. Borrowing from Prof. Philippe Aghion's U-inverted relationship, low interoperability (i.e., high appropriability) incentivizes innovation—this is the upward stage of the curve. Conversely, entry barriers would decrease when interoperability is introduced (either by regulatory mandate or by self-regulation). Thus, competition would increase but at the cost of innovation incentives—this is the downward stage of the curve. Consequently, it is important to preserve value appropriation with limited/no interoperability when technologies emerge to incentivize innovation. It is, however, desirable to spur competition when the market matures with greater interoperability standards. As the IoT technologies only emerge, antitrust regulators should refrain from adopting a precautionary approach toward antitrust enforcement in the IoT market: *ex ante* interventions to force interoperability at too early a stage of technological and market development shall undermine devices and services innovation. Forced interoperability toward innovative first mover may harm both innovations in the short term and the advent of a competitive environment in a subsequent stage of dispersed innovations. Indeed, interoperability suggests standardization, but "*if the standard is adopted too early it may limit innovation, and if poor choices are made in the standardization process, inferior technology may be adopted. These issues are difficult, probably impossible, to address under the antitrust rules.*"[46]

31. Against that background, the European Commission's Preliminary Report excessively narrows its focus (and concern) on three of the four companies present in the consumer voice assistant market. Such a discretely narrow focus precludes providing a wider picture of the IoT market. Rather, in the IoT market, the interwoven rivalry between hardware companies and information technology companies over connected products blurs the definition of relevant markets for antitrust purposes. Indeed, as Michael Porter and James Heppelmann write, "[i]*n many companies, smart, connected products will force the fundamental question, 'What business am I in?'*"[47] IoT companies create markets: It is a prime example of the competition for the market rather than competition within the market.

32. To be sure, innovators who create new IoT markets benefit from the first-mover advantage by amassing data stroves and having a reputational benefit over laggard firms. If technological costs are to be considered as barriers to entry, these barriers soon go down "*when smart, connected products leapfrog or invalidate the strengths and assets of incumbents*."[48] Thus, first movers have, per definition, a temporary competitive advantage: Network effects and scale economies lead to winner-take-most until innovations become ubiquitous and entrepreneurial rents attract new entrants.

33. The building of IoT capabilities is crucial to the competition on the merits—i.e., rewarding first movers and incentivizing viable entrants. Dynamic capabilities are "*the ability to integrate, build, and reconfigure internal and external competenc*[ies] *to address rapidly changing environments*."[49] In rapidly changing markets where IoT technologies already find useful appliances, dynamic capabilities are essential to outcompete rivals. For instance, when in 2000 the software company LG introduced "smart fridges," it gained a first-mover advantage which enabled the company to outcompete incumbents (such as Whirlpool, KitchenAid, Electrolux, etc.) but also competing electronics brands (such as Samsung, Thomson, GE, etc.). In other words, IoT-connected devices compete with traditional incumbents thanks to dynamic capabilities. These IoT capabilities are monitoring, control, optimization, and autonomy:

Figure 3.

Source: M. E. Porter, J. E. Heppelmann, How Smart, Connected Products Are Transforming Competition, *Harvard Business Review*, November 2014.

34. More generally, data quality provides firms with a competitive advantage on IoT capabilities: As "*companies are embracing new information-driven models to outperform their peers*," investments in data quality

46 K. Coates, *Competition Law and Regulation of Technology Markets* (Oxford: Oxford University Press, 2011), at 184.

47 M. E. Porter, J. E. Heppelmann, How Smart, Connected Products Are Transforming Competition, *op. cit.* note 29.

48 Ibid.

49 D. J. Teece, G. Pisano, A. Shuen, Dynamic capabilities and strategic management, *Strategic Management*, Vol. 18, Issue 7 (1997): 509–533, at 516.

can leverage IoT capabilities.[50] Consequently, big data analytics firms can enter the IoT market should they successfully leverage their market position. Antitrust enforcers notoriously overlook this aspect.

35. In the IoT market, competition with the large digital platforms of the Internet (such as Google, Amazon, Apple, etc.) remains marginal. Except in the niche market of voice assistants and home speakers, large digital companies have not captured significant market positions in popular IoT-connected devices such as light bulbs, home security, etc. It is unclear whether or not these companies are willing (or are capable) to enter into the numerous IoT-appliance markets. The dynamic capabilities of traditional market actors will be determinant in their ability to preclude the competitive entry of these large platforms.

36. Rather than portraying a lack of competition, the reality of the IoT competition reveals a fierce rivalry: among the 20 main rival companies competing for IoT device management, the large digital platforms operate within a competitive environment made by large traditional companies (such as GE, Bosch, Oracle, IBM, etc.) and specialized companies.[51] Also, historic companies such as BlackBerry re-emerges as IoT market leaders with their "QNX" real-time operating system.[52] Consequently, it is much too early to conclude that large digital platforms dominate the market for IoT device management: As such market emerges, the competitive constraints may also benefit traditional hardware companies or IoT-dedicated companies.

37. In conclusion, the current transatlantic momentum, which leads to considering that the IoT market has tipped in the benefit of few gatekeepers, not only ignores that the IoT market is considerably much larger than the market for customer voice assistants, where indeed few companies reached dominance currently via innovative devices, but it also overlooks the stage of developments of innovation as markets mature. Therefore, antitrust enforcers should refrain from engaging in precautionary interventions (in Europe) or resorting to incipiency doctrine (in the U.S.), else the innovative capabilities of entrepreneurs may suffer as investments and research may prove less attractive due to hasty prescriptive regulations.[53] *Ex ante* interventions before harm materialize undermine innovations, especially those arising out of the IoT since it remains an incipient market. All the more so since IoT technologies are about to be themselves disrupted by blockchain technology.[54] On the contrary, antitrust regulators should accompany and foster current interoperability standards whenever innovators and traditional actors find a venue for greater competition without harming innovation. ■

50 N. Côrte-Real, et al., *op.cit.* note 12.

51 G2, IoT in a Box Alternatives & Competitors, G2.com, https://www.g2.com/products/iot-in-a-box/competitors/alternatives (last access July 1, 2021).

52 Seeking Alpha, BlackBerry: A Contender in IoT Facing Stiff Competition, SeekingAlpha.com, March 8, 2021, https://seekingalpha.com/article/4412269-blackberry-contender-in-iot-facing-stiff-competition (last accessed July 1, 2021).

53 On the precautionary approach to antitrust in Europe, *see* A. Portuese *op.cit.* note 13; A. Portuese, European Competition Enforcement and the Digital Economy: The Birthplace of Precautionary Antitrust, *The Global Antitrust Institute Report on the Digital Economy* 17 (2020); A. Portuese, Precautionary Antitrust: A Precautionary Tale in European Competition Policy, in *Law and Economics of Regulation*, K. Mathis, A. Tor, eds. (Heidelberg: Springer, 2021), 203–232.

54 C. Septhon, Two companies form a partnership at the intersection of blockchain and IoT, *Cointelegraph*, June 10, 2021, https://cointelegraph.com/news/two-companies-form-a-partnership-at-the-intersection-of-blockchain-and-iot (last accessed on July 1, 2021); L. Horwitz, L. Rosencrance, How Blockchain Technology Can Benefit the Internet of Things, *IoT World Today*, May 31, 2021, https://www.iotworldtoday.com/2021/05/31/how-blockchain-technology-can-benefit-the-internet-of-things (last accessed on July 1, 2021); L. D. Xu, Y. Lu, L. Li, Embedding Blockchain Technology Into IoT for Security: A Survey, *IEEE*, Vol. 8, Issue 13 (2021): 10452–10473 (noting that "[t]*he integration and interoperation of blockchain and IoT is an important and foreseeable development in the computational communication system*"); M. Samaniego, U. Jamsrandorj, R. Deters, Blockchain as a Service for IoT, 2016 IEEE International Conference on Internet of Things; A. Panarello, N. Tapas, G. Merlino, F. Longo, A. Puliafito, Blockchain and IoT Integration: A Systematic Survey, *Sensors*, Vol. 18, Issue 8 (2018): 2575–2612 (noting that "[a]*n IoT ecosystem has numerous vulnerabilities concerning confidentiality, privacy, and data integrity. For this reason, the researchers and developers of the ICT sector decided to integrate 'security by design' technology within an environment such that IoT overcomes the limitations.* [Blockchain]*, being one such technology, grants authenticity, non-repudiation, and integrity by default, and utilizing smart contracts, manages authorization and automation of transactions as well*"); O. Novo, Blockchain Meets IoT: An Architecture for Scalable Access Management in IoT, *IEEE*, Vol. 5, Issue 2 (2018): 1184–1195; A. Dorri, S. S. Kanhere, R. Jurdak, Towards an Optimized Blockchain for IoT, 2017 IEEE/ACM Second International Conference on Internet-of-Things Design and Implementation (IoTDI); A. Reyna, C. Martín, J. Chen, E. Soler, M. Díaz, On blockchain and its integration with IoT. Challenges and opportunities, *Future Generation Computer Systems*, Vol. 88 (2018): 173–190.