RADICAL RESTORATIVE REMEDIES FOR DIGITAL MARKETS

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ABSTRACT

Much evidence from recent antitrust cases casts doubt on the ability of conventional remedies to restore competition in digital markets. This paper considers three untested remedies for antitrust enforcement in digital markets: mandatory sharing of algorithmic learning (rather than the data itself); subsidization of competitors; and temporary shutdowns. All three remedies are radical from several perspectives. First, they go beyond halting specific anticompetitive conduct by actively seeking to restore structural conditions favoring competition. Second, they entail government interference with freedom of enterprise and property rights to a substantially higher degree than the market-driven process which normally governs antitrust remedy design. Third, all three remedies create complex tradeoffs, in that they could lead either to competitive benefits (e.g., the entry of new firms) or to harms (e.g., consumer losses in cases of platform shutdowns or anticompetitive coordination in cases of algorithmic sharing). All three thus require careful balancing before implementation.

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I. INTRODUCTION

Digital markets challenge antitrust law in more than one way.[1] These challenges relate not only to the application of antitrust prohibitions but also

1. It is debated whether the characteristics of the digital economy make its markets special in a way that requires departure from established antitrust principles. *See, e.g.*, JACQUES CRÉMER, YVES-ALEXANDRE DE MONTJOYE & HEIKE SCHWEITZER, EUROPEAN COMM'N—COMPETITION, COMPETITION POLICY FOR THE DIGITAL ERA (2019), http://ec.europa.eu/competition/publications/reports/kd0419345enn.pdf [hereinafter EU REPORT]; Pablo

to the design of remedies aimed at restoring competition. Designing remedies is difficult because the market power of monopoly firms in digital markets appears more durable than that of most monopoly firms in brick-and-mortar markets. Network effects, economies of scale and scope, and learning-by-doing effects combine to create substantial incumbency advantages and qualitatively stronger monopoly positions.[2] Furthermore, economic theory suggests that, in some digital markets, substituting rivalry for monopoly is not Pareto efficient because users derive increasing marginal benefits from the size of a single supplier.[3] Conventional antitrust remedies might thus not restore competition in digital markets. This, in turn, motivates a search for alternative remedies. This task is of utmost importance for ensuring that technological innovation delivers improvements in consumer welfare. Moreover, the design of effective remedies affects incentives to bring antitrust suits in the first place and is thus a condition of effective enforcement. The remedial issue is also timely in light of investigations recently opened against digital firms.[4]

Antitrust remedies seek to deter anticompetitive conduct. But antitrust remedies serve an additional purpose after occurrence of anticompetitive

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Ibáñez Colomo, *The Report on "Competition Policy for the Digital Era" Is Out: Why Change the Law if There is No Evidence? And How?*, CHILLIN' COMPETITION (Apr. 5, 2019, 9:47 AM), https://chillingcompetition.com/2019/04/05/the-report-on-competition-policy-for-the-digital-era-is-out-why-change-the-law-if-there-is-no-evidence-and-how/. In our view, it is their unique combination of characteristics which makes such markets special.

2. Several antitrust authorities and institutions have conducted studies into the key issues affecting competition in digital markets. *See, e.g.*, DIGIT. COMPETITION EXPERT PANEL, UNLOCKING DIGITAL COMPETITION (2019), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785547/unlocking_digital_competition_furman_review_web.pdf [hereinafter UK REPORT]; EU REPORT, *supra* note 1; STIGLER CTR. FOR THE STUDY OF THE ECON. & THE STATE, STIGLER COMM. ON DIGIT. PLATFORMS: FINAL REPORT (2019), https://www.chicagobooth.edu/-/media/research/stigler/pdfs/digital-platforms---committee-report---stigler-center.pdf [hereinafter STIGLER REPORT]; AUSTRALIAN COMPETITION & CONSUMER COMM'N, DIGITAL PLATFORMS INQUIRY: FINAL REPORT (2019), https://www.accc.gov.au/system/files/Digital%20platforms%20inquiry%20-%20final%20report.pdf [hereinafter AUSTRALIAN REPORT].

3. Emilio Calvano & Michele Polo, *Market Power, Competition and Innovation in Digital Markets: A Survey*, INFO. ECON. & POL'Y (2021), https://doi.org/10.1016/j.infoecopol.2020.100853.

4. *See, e.g.*, Eur. Comm'n Press Release IP/19/4291, Antitrust: Commission Opens Investigation into Possible Anti-Competitive Conduct of Amazon (July 17, 2019), https://ec.europa.eu/commission/presscorner/detail/en/IP_19_4291. In February 2020, the Federal Trade Commission (FTC) asked Google, Amazon, Apple, Facebook, and Microsoft to provide information about merger and acquisition transactions not previously reported to antitrust agencies. Press Release, Fed. Trade Comm'n, FTC to Examine Past Acquisitions of Large Technology Companies (Feb. 11, 2020), https://www.ftc.gov/news-events/press-releases/2020/02/ftc-examine-past-acquisitions-large-technology-companies.

conduct. They seek to restore a competitive equilibrium as close as possible to the "but for" world that would have prevailed absent the anticompetitive conduct, while not imposing excessive implementation costs on antitrust courts and agencies and preventing the reoccurrence of the unlawful conduct. It is generally agreed that antitrust remedies applied to date in digital markets have not met these goals and have largely been ineffective. Hefty fines have done little to change market conditions.[5] And other remedies have either taken a long time to produce effects or have been difficult to implement. In *U.S. v. Microsoft*, for example, the design of appropriate remedies was one of the most contentious and problematic issues. The disclosure and licensing requirements eventually imposed by antitrust agencies failed to open up operating system markets to competition.[6] Cases brought recently by the European Union (EU) tell a similar story. Antitrust remedies imposed in search engine, social network, and online retail markets have produced minimal impact on the competitive landscape.[7] Consumers remain subject to market power that has been unlawfully acquired or maintained, in spite of findings of liability.[8]

At best, antitrust enforcement might have been socially beneficial by virtue of its deterrent effect. Some have argued that the antitrust cases against Microsoft made it possible for Google to succeed (even though the relief did not jumpstart competition in operating systems) by making Microsoft less competitively aggressive in the long term.[9] Others claim that the failed government case against IBM made it possible for Microsoft to succeed.[10] In

5. For general propositions on why fines against large corporations fail, see BRANDON GARRETT, TOO BIG TO JAIL: HOW PROSECUTORS COMPROMISE WITH CORPORATIONS (Harvard University Press, 2014).

6. Renata B. Hesse, *Section 2 Remedies and* U.S. v. Microsoft*: What Is to Be Learned?*, 75 ANTITRUST L.J. 847 (2009).

7. Foo Yun Chee & Victoria Waldersee*, EU's Vestager Says Google's Antitrust Proposal Not Helping Shopping Rivals*, REUTERS (Nov. 7, 2019), https://www.reuters.com/article/us-eu-alphabet-antitrust/eus-vestager-says-googles-antitrust-proposal-not-helping-shopping-rivals-idUSKBN1XH2I8.

8. *See infra* Part II.

9. This is a recurring theme in Brad Smith's interview with Kara Swisher. *See* Kara Swisher, *Microsoft President Brad Smith: Fixing What Silicon Valley Broke is Every Tech Company's Responsibility*, RECODE DECODE (Sept. 9, 2019), https://www.vox.com/recode/2019/9/9/20857655/brad-smith-microsoft-tools-weapons-book-regulation-antitrust-kara-swisher-recode-decode-podcast (referring to the podcast within the written article). Microsoft itself adopted a series of interoperability principles in 2008 which were not required under the antitrust remedial orders. *See Interoperability Principles Program*, MICROSOFT (Mar. 12, 2020), https://docs.microsoft.com/en-us/openspecs/dev_center/ms-devcentlp/d84cac00-b312-44ee-9156-23bde6477c3d?redirectedfrom=MSDN#Principles.

10. *See, e.g.*, Steven W. Usselman, *Public Policies, Private Platforms: Antitrust and American Computing*, *in* INFORMATION TECHNOLOGY POLICY: AN INTERNATIONAL HISTORY 97

such cases, however, the cognitive impact of the antitrust case is not a "restorative effect" in the sense that it does not produce direct, immediate effects on competition in a specifically defined antitrust relevant market. Furthermore, the failure of antitrust remedies so far to restore lost competition due to antitrust violations in the digital economy has led to exploration of more interventionist regulatory measures that apply *ex ante*.[11]

This state of affairs requires new thinking. Leaving aside proposals for regulatory reform calls for bolder antitrust remedies to revisit ideas from the past. Structural break-ups,[12] mandatory sharing of data inputs,[13] non-discrimination obligations,[14] or forced interoperability[15] all sit squarely within traditional antitrust solutions. Most of these remedies have also already been tried, often in relation to other disruptive technologies (like oil refining, the telegraph, radio communications, or the printed press). There is mixed empirical evidence that these remedies effectively restored competition.[16] Furthermore, some might involve high costs when applied to digital markets. For example, break-ups might reduce the benefits to users arising from significant network effects and the spillovers that platforms, and their business partners realize through economies of scale and scope.

Against this backdrop, this paper discusses three alternative antitrust remedies: mandatory sharing of algorithmic learning, subsidization of

(Richard Coopey ed., 2004) ("Antitrust action, though not resulting in an ultimate victory for government in the courts, prompted IBM to alter its business practices in fundamental ways and in the process created a distinct market for computer software."). For a critique of this argument, see Benedict Evans, *How to Lose a Monopoly*, BENEDICT EVANS (Jan. 1, 2020), https://www.ben-evans.com/benedictevans/2020/01/01/microsoft-monopoly-and-dominance.

11. One major example involves the EU recent discussion of a "New Competition Tool" for digital platforms. *See* Samuel Stolton, *New Competition Tool' to Feature in Digital Services Act, Vestager Says*, EURACTIVE (May 10, 2020), https://www.euractiv.com/section/digital/news/new-competition-tool-to-feature-in-digital-services-act-vestager-says/. For discussion of the regulatory options, see Giorgio Monti, *Attention Intermediaries: Regulatory Options and Their Institutional Implications*, TILLBURG L. &. ECON. CTR. (July 9, 2020), https://ssrn.com/abstract=3646264.

12. *See generally* Nicholas Thompson, *Tim Wu Explains Why He Thinks Facebook Should Be Broken Up*, WIRED (May 7, 2019), https://www.wired.com/story/tim-wu-explains-why-facebook-broken-up/ (analyzing the benefits of breaking large platforms, such as Facebook, into smaller companies).

13. *See generally* UK REPORT, *supra* note 2; EU REPORT, *supra* note 1; INGE GRAEF, EU COMPETITION LAW, DATA PROTECTION AND ONLINE PLATFORMS: DATA AS ESSENTIAL FACILITY (2016).

14. *See* Kevin Caves & Hal Singer, *When the Econometrician Shrugged: Identifying and Plugging Gaps in the Consumer Welfare Standard*, 26 GEO. MASON L. REV. 395 (2018).

15. *See* STIGLER REPORT, *supra* note 2, at 16.

16. Such an analysis is beyond the scope of this paper.

competitors, and temporary shutdowns. All three remedies lie at the outer boundary of established antitrust practice. Yet all can potentially be imposed by antitrust decision makers.

Mandatory sharing of algorithmic learning has some similarities with data sharing remedies but goes one step further.[17] The remedy orders a monopoly incumbent to share the knowledge produced by learning algorithms trained on data unlawfully collected or exploited. As it will be shown, under some circumstances this remedy can swiftly level the playing field between a monopolist and rivals by forcing the monopolist to share his unlawfully acquired comparative advantage, while avoiding some of the problems involved with data sharing remedies, most importantly the risk of increasing privacy harms.

Subsidization of competitors is more interventionist. Here, the idea is to allow rivals of a monopolist in a digital market to bid for subsidies in exchange for a commitment to supply a service under price or non-price terms that create a consumer welfare improvement. The remedy might be used to promote competitive commoditization, leading to lower consumer prices. Or it might be used to encourage competitive differentiation. For example, the subsidy might be designed in a way that provides for the entry of business models less reliant on personal data, targeted advertising, or competition for attention. Fines imposed on incumbent monopolists for antitrust violations might be used to finance such subsidies.

Temporary shutdowns are even more extreme. The immediate effect of a temporary shutdown is to force users to migrate to an alternative service, at least for the duration of the shutdown. Its intermediate purpose is to promote competitive entry or expansion and multi-homing by addressing specific characteristics of digital markets like incumbency advantages, learning effects, and high search and switching costs.

All three proposed remedies are radical in more than one way. First, they go beyond halting specific anticompetitive conduct or imposing financial sanctions. Their goal is to change the dynamics of the market equilibrium produced by an antitrust violation, by attacking entrenching features such as incumbency advantages, large returns to scale and scope, the significance of data as a competitive advantage, and strong network effects. Second, the remedies entail a degree of government interference with freedom of enterprise and property rights which is substantially higher than that associated with the market-driven process which normally governs the design of antitrust remedies. However, the remedies all aim to restore the competitive process,

17. *See infra* Part III.

not to impose a competitive outcome. As such, they fall short of more interventional forms of economic regulation.[18] Third, the remedies generate complex tradeoffs which must be carefully balanced, as they could lead to either consumer welfare gains (such as increased product variety with the introduction of a new competitor) or losses (such as switching costs or sacrifices in the short-term performance of users in case of a shutdown).

Conventional antitrust remedies require agencies and courts to understand how markets work today and how they will work in the future. This is not an easy task. In addition, the radical antitrust remedies discussed in this paper face two key difficulties. The first is contextual. Digital markets are characterized by technological dynamism. As such, predicting the evolution of competition in social networks, for example, is more difficult than making such predictions for, say, the cement market. The second difficulty is informational. The three radical remedies suggested have never been tried by antitrust courts and agencies. Accordingly, any assessment of their costs and benefits is speculative.

And yet, despite these problems, it is crucial that we test the boundaries of current antitrust thinking. In their book, *Radical Markets*,[19] Glen Weyl and Eric Posner argue that we can fundamentally reduce consumer harm in digital markets without the adoption of new legislation through innovative application of existing laws, including antitrust law.[20] This paper pursues that ambition. This is not to say that we necessarily advocate the adoption of any or all of the three remedies. Rather, we aim to discuss their potential in restoring competition, a goal at which traditional remedies have largely failed.

To that end, we start by reviewing the goals of antitrust remedies and the reasons why the special features of digital markets motivate an exploration of remedial roads less travelled (Part II). The three radical remedies are then described. Our discussion outlines the rationale behind each remedy, highlights examples from non-antitrust contexts, lays out conditions for their application in an antitrust context, and points to possible virtues and problems (Parts III–V). The paper closes with some general observations (Part VI).

18. As Stephen Breyer has put it, antitrust achieves workable competition indirectly, while "[e]conomic regulation bypasses the competitive process and seeks to obtain these benefits directly." Stephen G. Breyer, *Antitrust, Deregulation, and the Newly Liberated Marketplace*, 75 CALIF. L. REV. 1005, 1006 (1987).

19. GLEN WEYL & ERIC POSNER, RADICAL MARKETS: UPROOTING CAPITALISM AND DEMOCRACY FOR A JUST SOCIETY (2019).

20. *See generally id.*

II. THE NEED TO EXPLORE RADICAL REMEDIES

Antitrust remedies are ultimately restorative.[21] Beyond deterring unlawful business conduct, they seek to restore the competitive conditions that would have existed absent the antitrust violation, or that pre-dated it.[22] Restorative remedies generally include either a prohibitory injunction against specific conduct, a mandatory injunction regulating conduct, or a structural injunction requiring a firm to divest (or not acquire) assets.[23] While the practice of U.S. agencies has historically focused on remedies that prohibit unlawful business conduct, often through the use of proscriptive injunctions like cease-and-desist orders, other agencies have placed more emphasis on removing anticompetitive effects (such as a distorted market structure), often through the use of prescriptive injunctions like access and disclosure orders.[24]

Recent remedy practice in the United States has, however, increasingly gone beyond simple conduct proscriptions to introduce more access and disclosure remedies.[25] While the United States has a history of antitrust

21. The Supreme Court has long held that the purpose of antitrust remedies is restorative. *See* Nat'l Soc'y of Pro. Eng'rs v. U.S., 435 U.S. 679, 698 (1978) (holding that remedies are supposed to provide "a reasonable method of eliminating the consequences of the illegal conduct"); *see also* U.S. v. E.I. du Pont de Nemours & Co., 366 U.S. 316, 326 (1961) ("The key to the whole question of an antitrust remedy is of course the discovery of measures effective to restore competition."). EU law also suggests, though less explicitly, that remedies are restorative. The law entitles agencies to impose behavioral or structural remedies so as to bring the infringement effectively to an end. *See* Council Regulation No. 1/2003 of 16 Dec. 2002 on the Implementation of the Rules on Competition Laid Down in Articles 81 and 82 of the Treaty, Art. 7, 2003 O.J. (L 1) 9 (EC) (stating that the Commission "may impose on them any behavioral or structural remedies which are proportionate to the infringement committed and necessary to bring the infringement effectively to an end"). EU officials have interpreted the term "effectively" to mean that the Commission can seek to remove both past and future effects of the infringement. *See* Frank P. Maier-Rigaud & Philip Lowe, *Quo Vadis Antitrust Remedies*, *in* ANNUAL PROCEEDINGS OF THE FORDHAM COMPETITION LAW INSTITUTE: INTERNATIONAL ANTITRUST LAW & POLICY 597, 597–611 (Barry Hawk ed., 2008) ("They ensure that competition at least as it was prior to the infringement is restored."). Few EU Court decisions clearly discuss the purpose of antitrust remedies in Europe, though in *Akzo* the Court said that it was not unfair for the EC to order measures that "re-establish the situation that existed before the [antitrust] dispute." *See* Case C-62/86, Akzo Chemie BV v. Comm'n, 1991 E.C.R. I-03359, at 286.

22. *See* E. Thomas Sullivan, *Antitrust Remedies in the U.S. and EU: Advancing a Standard of Proportionality*, 48 ANTITRUST BULL. 377, 420 (2003).

23. William H. Page, *Mandatory Contracting Remedies in the American and European Microsoft Cases*, 75 ANTITRUST L.J. 787 (2009).

24. *See* Sullivan, *supra* note 22, at 378.

25. Spencer Weber Waller, *Access and Information Remedies in High-Tech Antitrust*, 8 J. COMPETITION L. & ECON. 575 (2012).

breakups,[26] this option is mostly a vestige of the past. No breakups have been imposed in digital markets, although some scholars have supported such an eventuality.[27] Regardless, it is noteworthy that antitrust laws do not prescribe rigid lists of remedies. Rather, the design of restorative remedies is subject to broad doctrinal imperatives which leave substantial discretion to agencies and courts. Restoring competition following violations of antitrust law in digital markets creates unique difficulties, distinct from those encountered in most brick-and-mortar industries. In what follows, we first consider how the economic characteristics of digital markets shape the nature of competition (A). We then discuss the specific challenges to restoring competition in digital markets (B). Following that, we show how the economic characteristics of digital markets plausibly explain the unsatisfactory experience with antitrust remedies in digital markets to date (C).

A. ECONOMIC CHARACTERISTICS OF DIGITAL MARKETS

Digital markets are characterized by several economic features. Two are especially important. First, digital markets are often subject to economies of scale and scope, where increasing returns to production and diversification are substantial.[28] Economies of scale and scope are supply-side economies in which the unit cost of production falls with rising output or a larger product range, respectively. In some digital markets, such economies are relatively high because information goods and services have low marginal costs of production and distribution. This is particularly true of data-driven markets.[29] Second, network effects frequently characterize digital markets and are often

26. The EC has not imposed structural remedies under Regulation No 1/2003. *See* Cyril Ritter, *How Far Can the Commission Go When Imposing Remedies for Antitrust Infringements?*, 7 J. EUR. COMPETITION L. & PRAC. 587 (2016).

27. *See* Thompson, *supra* note 12. Note that the district court in the U.S. *Microsoft* case had initially ordered a breakup. *See* United States v. Microsoft Corp., CA No. 98-1232, 11–3 (CKK), filed Nov. 12, 2002 (D.D.C. 2002) [hereinafter US Microsoft Decision], available at https://www.justice.gov/atr/case-document/file/503541/download.

28. Contrary to common belief, digital markets are not always characterized by market power increasing economies of scale and scope, and these markets may also be subject to diseconomies of scale and scope that limit market power. For an extensive discussion, see Timothy F. Bresnahan, Shane Greenstein & Rebecca M. Henderson, *Schumpeterian Competition and Diseconomies of Scope: Illustrations from the Histories of Microsoft and IBM*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY REVISITED (Josh Lerner & Scott Stern eds., 2012). Much depends on the quality of the data, the task, and the level of accuracy required.

29. *See* STIGLER REPORT, *supra* note 2, at 29; *see also* Keith Hylton, *Digital Platforms and Antitrust Law* (2019) (No. 19-8 Boston University School of Law, Law and Economics Research Paper), https://scholarship.law.bu.edu/cgi/viewcontent.cgi?article=1606&context=faculty_scholarship (discussing the substantial relationship between antitrust law and data driven markets).

substantial. Network effects are demand-side benefits that exist when the value to a new user from adopting a service increases in line with the number of users who have already adopted it.[30] Digital services are a prime example of a technology with significant network effects.[31] As noted in the 2019 Stigler Report, while such economic features are not novel, their combination is unique.[32]

In digital markets with significant scale and scope economies and substantial network effects, the market is prone to tipping and competition often operates *for* the market.[33] The firm that is first to reach a critical mass of users becomes the single (or the main) supplier, by virtue of a self-reinforcing, positive feedback loop.

Economists do not view the absence of competition *in* the market as a sufficient condition for the existence of a market failure.[34] In the presence of high transaction costs—e.g., costs accruing from compatibility, interoperability, or multi-homing issues, as well as switching costs—a monopoly structure may maximize social surplus.[35] Put simply, users can

30. Hal R. Varian, Use and Abuse of Network Effects 3 (Aug. 7, 2018) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3215488. Network effects can also be indirect. This is the case when the value to a new user from adopting a product/service (for example, buyers of video game consoles) is increasing in relation to the number of non-user third parties (for example, developers of video game software) who have adopted it.

31. *See generally* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY (1998).

32. *See* STIGLER REPORT, *supra* note 2. In some markets, users' behavioral biases—such as the tendency to stick to default options and bounded rationality—might further increase entry barriers. *Id.* at 38. Evidence of multi-homing shows that in some markets such effects might not be significant.

33. *See* STIGLER REPORT, *supra* note 2, at 35 ("When markets are prone to tipping, the competitive process shifts from competition in the market to competition for the market."); *see also* COUNCIL OF ECON. ADVISORS, 2020 ECONOMIC REPORT OF THE PRESIDENT 218 (Feb. 20, 2020) [hereinafter COUNCIL OF ECONOMIC ADVISORS] ("In markets with network effects or other types of economies of scale, firms may compete for the entire market, rather than for shares in the market.").

34. *See* UK REPORT, *supra* note 2, at §§ 1.96–1.97 ("Concentrated market shares at a single point in time do not necessarily mean inadequate competition. This is because having one or two companies controlling high levels of market share is only an indication that there is a low level of competition 'in the market.' An alternative constraint on the behavior of firms towards their customers can occur through competition for the market. When this form of competition takes place, the benefits of highly competitive markets are felt due to markets being contestable. So long as a market is contestable, a firm in a monopoly position will know it must work hard to meet consumers' needs and stay ahead of potential rivals.").

35. *See* Nicholas Economides, *Competition Policy in Network Industry: An Introduction*, *in* THE NEW ECONOMY AND BEYOND: PAST, PRESENT AND FUTURE 96, 106 (Dennis W. Jansen ed.,

derive maximum utility from affiliation to a single network.[36] Moreover, the existence of multiple platforms competing *in* the market for a non-transitory period of time might involve wasteful duplication. As Bresnahan and others suggest, such costs are borne in substantial part by users and developers, rather than by platform suppliers.[37] Both sides may indeed delay entry or adoption due to uncertainty about when the market will tip.

What matters more, therefore, is to maintain the disciplining force of competition *for* the market, which exerts competitive pressure on incumbents.[38] Yet such competition is not a given. In digital markets, equally or more-efficient entrants with otherwise better products or services might in some circumstances not be able to challenge and win the market merely because they cannot provide users with the utility that stems from a large installed base or from the exploitation of sizeable datasets.[39] Economists refer to this as an incumbency advantage.[40] At the same time, the role of data as a barrier to entry depends on the attributes and context of each market.[41] Business and management science highlights that in digital environments, the rapid obsolescence of data inputs and outputs means that firms face volatility, risk, and uncertainty.[42] Moreover, economists have shown that it is wrong to assume that all or most digital markets will tip. On the contrary, the empirical reality of some digital markets, like mobile applications ecosystems, is one of

2006) ("In industries with significant network externalities, under conditions of incompatibility between competing platforms, monopoly may maximize social surplus."); Calvano & Polo, *supra* note 3, at 1 ("Concentration maximizes gross consumers' surplus when network effects are in place, but its benefits have to be weighed against costs due to market power.").

36. *See* Justus Haucap & Ulrich Heimeshoff, *Google, Facebook, Amazon, eBay: Is the Internet Driving Competition or Market Monopolization?*, 11 INT'L ECON. & ECON. POL'Y 49, 49, 52 (2014) ("Network effects often make large platform sizes indispensable in order to achieve an efficient utilization of the platform. Hence, high market concentration levels cannot simply be interpreted in the same manner as in conventional markets without network effects. . . . In addition, it is not even clear from a theoretical point of view whether competition between several platforms is necessarily welfare enhancing when compared to monopolistic market structures.").

37. *See* Timothy Bresnahan, Joe Orsini & Pai-Ling Yin, *Demand Heterogeneity, Inframarginal Multihoming, and Platform Market Stability: Mobile Apps* (NBER Working Paper, 2014).

38. *See* Calvano & Polo, *supra* note 3, at 9.

39. *See* STIGLER REPORT, *supra* note 2, at 40.

40. *See* STIGLER REPORT, *supra* note 2, at 35.

41. *See* COUNCIL OF ECONOMIC ADVISORS, *supra* note 33, at 219.

42. *See* Ioanna D. Constantiou & Jannis Kallinikos, *New Games, New Rules: Big Data and the Changing Context of Strategy*, 30 J. INFO. TECH. 44, 52–53 (2015); Anandhi Bharadwaj, Omar A. El Sawy, Paul A. Pavlou & N. Venkatraman, *Digital Business Strategy: Toward a Next Generation of Insights*, 37 MIS Q. 474, 476 (2013); Sungwook Min, Manohar U. Kalwani & William T. Robinson, *Market Pioneer and Early Follower Survival Risks: A Contingency Analysis of Really New Versus Incrementally New Product-Markets*, 70 J. MKTG. 1 (2006).

stable fragmentation—effectively the opposite of tipping.[43] But when incumbency advantages are significant, what a benevolent social planner might want to encourage is not so much direct competition by rivalry in the short term, but displacement of competition in the mid to long term. That is Schumpeterian competition, whereby "creative destruction" displaces incumbents through innovation.[44] For example, IBM's dominance on mainframes was displaced by the rise of the Windows operating systems controlled by Microsoft, which was itself displaced by the emergence of portable devices, the internet, and intermediating platforms like search engines, social networks, and peer-to-peer applications.[45]

In some cases, though, the characteristics surveyed above lead to durable market power. The anecdotal evidence is confirmative. Many digital markets are characterized by extremely high profit margins and no new relevant entries, a sign of significant barriers to entry including, possibly, strategic entry deterrence.[46] By conservative standards, absence of competitive entry over a period of five years invites antitrust concerns.[47] Firms like Google and Facebook have not seen erosion in their dominant positions within their core markets for more than a decade.[48]

The concerns associated with the possibility of digital firms accruing durable market power are diverse. First, there is a possible loss of allocative, productive, and dynamic efficiency. Firms with cost or quality advantages might be prevented from entering the market, and incentives of incumbent firms to develop consumer welfare-enhancing innovations could be suppressed.[49] Second, there is no guarantee that the product or service offered by the incumbent monopolist is the best one. Economist Brian Arthur has demonstrated how random events and trivial circumstances can lock a market into a suboptimal technological equilibrium.[50] For example, the VHS standard won the video cassette recording market, though Betamax was often described

43. *See* Bresnahan, Orsini & Yin, *supra* note 37, at 1–2.

44. *See generally* JOSEPH SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT (1934).

45. *See* Evans, *supra* note 10.

46. *See* STIGLER REPORT, *supra* note 2, at 9, 34.

47. *See* Frank H. Easterbrook, *The Limits of Antitrust*, 63 TEX. L. REV. 1, 33 (1984).

48. *See* UK REPORT, *supra* note 2, at 25, 39, 91.

49. *See* STIGLER REPORT, *supra* note 2, at 8 ("[M]arket power may manifest itself through lower quality, lower privacy protection . . . less variety of political viewpoints, and, importantly, less investments in innovation.").

50. *See generally* W. Brian Arthur, *Competing Technologies, Increasing Returns, and Lock-In by Historical Events*, 99 ECON. J. 116 (1989) [hereinafter Arthur, *Competing Technologies*]; W. BRIAN ARTHUR, INCREASING RETURNS AND PATH DEPENDENCE IN THE ECONOMY, 13–5 (1994).

as technically superior.[51] The process of Schumpeterian competition might thus be truncated. In this paper, we assume that these problems exist in the real world but stress that the available empirical evidence remains difficult to interpret.[52]

B. CHALLENGES IN RESTORING COMPETITION IN DIGITAL MARKETS

Antitrust in digital markets has two perceived problems: it is weak, and it is slow.[53] Scholars primarily blame the liability or evidentiary standards embedded in antitrust laws for this unfortunate state of affairs.[54] But both criticisms are also highly relevant to the design of remedies.[55] This is because they reveal a frustration with the inability of antitrust law to remove durable monopoly power attained or sustained by digital firms as a result of unlawful business conduct, be it concerted action, unilateral monopolization, or anticompetitive mergers and acquisitions.[56] In what follows, we point to six main causes explaining the failure of remedies in many digital markets to restore competition.

First, and most importantly, once a monopolist accumulates significant comparative advantages based on scale, scope, and network effects, a potential competitor with identical cost functions, capabilities, and resources might find it difficult to replicate such advantages. Microsoft's unsuccessful attack on Google in the search engine market is anecdotal evidence of this problem.[57] At that stage, monopoly power may be durable, without a need for the monopolist to engage in exclusionary conduct, even if such conduct was employed in the

51. W. Brian Arthur, *Positive Feedbacks in the Economy*, SCIENTIFIC AMERICAN, 92 (1990).

52. One of us has shown how and why the idea that durable market power is an industry-level regularity in digital markets invites some degree of skepticism and is largely based on theoretical concerns and methodological choices. *See* NICOLAS PETIT, BIG TECH & THE DIGITAL ECONOMY: THE MOLIGOPOLY SCENARIO (2020).

53. *See* Andrew I. Gavil, *The End of Antitrust Trench Warfare?: An Analysis of Some Procedural Aspects of the Microsoft Trial*, 13 ANTITRUST 7 (1998).

54. For example, some have advocated direct changes to substantive antitrust doctrine, and in particular a relaxation of the threshold condition of monopoly power (or substantial market power) specific to digital markets cases. *See*, *e.g.*, EU REPORT, *supra* note 1, at 48–49.

55. The European Commission has just applied interim measures in an antitrust case for the first time in twenty years. *See* European Commission Press Release IP/19/6109, Antitrust: Commission Imposes Interim Measures on Broadcom in TV and Modem Chipset Markets (Oct. 16, 2019), https://ec.europa.eu/commission/presscorner/detail/en/IP_19_6109 (highlighting that the European Commission declined to apply interim measures in antitrust cases for the 20 years leading up to the Broadcom case).

56. For a formulation of this criticism, see Matt Stoller, *How Russian Antitrust Enforcers Defeated Google's Monopoly*, BIG (July 23, 2019), https://mattstoller.substack.com/p/how-russian-antitrust-enforcers-defeated.

57. Ulrich Dolata, *Apple, Amazon, Google, Facebook, Microsoft: Market Concentration—Competition—Innovation Strategies* 6–7 (SOI discussion paper, No. 2017-01, 2017).

past to gain or strengthen its market position. Accordingly, simply policing the monopolist's conduct once incumbency advantages are significant, or imposing financial penalties, may do little to restore competition. Rather, remedies should focus on preventing the monopolist from continuing to enjoy unlawfully acquired or maintained advantages and reducing entry barriers for other competitors. The level at which a monopolist's comparative advantages give rise to an insuperable barrier to entry is, however, an issue of unresolved empirical disagreement and one where false positives or false negatives are likely to be inevitable.[58]

Second, restorative remedies aim at re-establishing the competitive conditions that would have prevailed *but for* the infringement.[59] This might be done by attempting to move the market back to the status quo that existed before the violation or to a conjectured competitive equilibrium. But the elaboration of a counterfactual is highly problematic in markets where network effects and scale and scope economies are substantial. The infringing firm might have reached critical mass by virtue of random events during the adoption phase,[60] competition on the merits, anticompetitive conduct, or some combination of all of these. Under such circumstances, setting a counterfactual is more difficult than in merger cases. In the latter, the assessment is forward-looking and takes the existing market conditions as a baseline. In restoring competition, however, the analysis is both forward- and backward-looking: the antitrust decision maker must assess the long-term effects on market conditions that have resulted from the anticompetitive conduct, as well as the likelihood that market forces will erode them in the short to medium run. Moreover, when competition is *for* the market, the counterfactual is a monopoly structure. This confronts antitrust agencies and courts with daunting questions: which of the various nascent network technologies had the best potential to win the race to monopoly, and should resources be expended on changing the monopoly firm?[61]

58. *See* COUNCIL OF ECONOMIC ADVISORS, *supra* note 33, at 218–19.

59. This difficulty is also relevant to the three remedies explored in this paper. Indeed, in our view it is the single most significant limitation of restoration remedies. It is difficult to assess what market conditions would have existed absent such long-term effects. Accordingly, the remedy should not be applied unless it is abundantly clear that it will not go (much) beyond restoring competition. Such remedies should only be applied following (and based on) development of guidelines that are transparent to all market participants. This is necessary to ensure clarity and transparency and to limit discretion.

60. Arthur, *Competing Technologies*, *supra* note 50, at 116.

61. For an overview of these problems, see Paul A. David, *Some New Standards for the Economics of Standardization in the Information Age*, *in* ECONOMIC POLICY AND TECHNOLOGICAL PERFORMANCE 206 (Partha Dasgupta & Paul Stoneman eds., 1987).

Third, antitrust remedies generally attempt to restore competition *in* the market by lowering entry barriers and increasing rivalry. The remedies applied by the European Commission (EC) in the *Google Shopping* case illustrate this. The EC sought to reinject rivalry into the market for comparison shopping websites by subjecting Google to a must-carry obligation, and by forbidding it to treat competing comparison-shopping services less favorably than its own such service.[62] A remedial focus on competition *in* the market could lead to inefficiency in some digital markets. As hinted above, deviations from rivalry towards monopoly might be socially efficient when compatibility, interoperability, multi-homing, and switching costs are non-trivial. To be sure, if these costs are low, or if it is technically feasible to apply remedies that reduce these costs, there might be a case for antitrust remedies that promote competition *in* the market. But this is an empirical question.

Fourth, by design, antitrust law is biased towards remedies that restore competition by direct competitors selling substitute products or services. The European decision in *Microsoft* illustrates this point. The Commission expressly mandated disclosure of interoperability information in order to allow Microsoft's competitors to develop products that "viably compete with Microsoft's work group server operating system."[63] However, this approach might not work in digital markets where significant incumbency advantages make it difficult for established firms to dislodge the market leader through head-to-head competition. In their seminal work on the computer industry, Bresnahan and Greenstein showed that successful competition in markets characterized by significant network effects often occurs by indirect entry, through product differentiation.[64] The remedies applied in the U.S. *Microsoft* case were more in line with this insight, since the "longer-term goal [was] to preserve a 'platform threat' to the Windows monopoly posed by middleware running on servers," not necessarily by substitute server operating systems.[65]

62. *See* Summary of Commission Decision of 27 June 2017 Relating to a Proceeding Under Article 102 of the Treaty on the Functioning of the European Union and Article 54 of the EEA Agreement (Case AT.39740—Google Search (Shopping)), 2018 O.J. (C 9), § 699–701 [hereinafter Google Shopping]. A controversy exists whether the remedy implemented by Google satisfies these conditions.

63. Case T-201/04 Microsoft v. Commission, 2007 E.C.R. II-3601 at § 1003 [hereinafter EU Microsoft Decision] ("The objective of this Decision is to 'ensure that Microsoft's competitors can develop products that interoperate with the Windows domain architecture natively supported in the dominant Windows client PC operating system and hence viably compete with Microsoft's work group server operating system.' ").

64. *See* Timothy F. Bresnahan & Shane Greenstein, *Technological Competition and the Structure of the Computer Industry*, 47 J. INDUS. ECON. 1 (1999).

65. Page, *supra* note 23, at 801.

Fifth, antitrust agencies and courts favor instant remedies. Resources are limited, and ongoing supervision often involves skills that are in short supply. As the Supreme Court stated in *Trinko*, "an antitrust court is unlikely to be an effective day-to-day enforcer of [. . .] detailed sharing obligations."[66] A policy preference thus exists towards remedies that do not involve continual supervision, such as structural changes or simple cease-and-desist orders. Yet in some digital markets repeated antitrust intervention to reset the competitive process will be needed, if and when another firm engages in anticompetitive conduct that will re-tip the market and create another monopoly. To be sure, antitrust agencies might avoid costly supervision by outsourcing it to third parties. In *Microsoft*, the court ordered the creation of a three-person Technical Committee whose role was to monitor Microsoft's compliance, evaluate third-party complaints, and propose ways to cure violations.[67] For some observers, the Technical Committee is one of the success stories of the *Microsoft* saga.[68] However, outsourcing remedies is associated with agency and legitimacy problems, especially when experts are funded by antitrust infringers. This led the EU General Court in *Microsoft* to object to the appointment of an independent trustee paid by Microsoft to oversee the implementation of a disclosure remedy.[69]

Sixth, it is not new that antitrust remedies take time to produce effects. This is because courts and agencies are understandably reluctant to neutralize the comparative advantages of the incumbent and prefer to lower barriers so that entrants can also gain comparable competitive advantages.[70] In digital markets, gaining such benefits is no quick or easy task due to constraints resulting from the economic features of digital markets. To see this, consider a remedy that requires a monopolist to terminate exclusionary contracts that limit the ability of competitors to gather the data necessary for their operations. Where there are significant returns to scale and scope in data analysis, it will take time for rivals to accumulate sufficient data and turn it into valuable

66. Verizon Comms. Inc. v. L. Offs. of Curtis V. Trinko, 540 U.S. 398, 415 (2004).

67. US Microsoft Decision, *supra* note 27. The Technical Committee was composed of three members with technical and business experience in software design and programming.

68. *See* Hesse, *supra* note 6, at 860–61.

69. *See* EU Microsoft Decision, *supra* note 63.

70. This idea is famously embodied in the *Alcoa* opinion where the Court affirmed liability but noted that "[a] single producer may be the survivor out of a group of active competitors, merely by virtue of his superior skill, foresight and industry. In such cases a strong argument can be made that, although the result may expose the public to the evils of monopoly, the Act does not mean to condemn the resultant of those very forces which it is its prime object to foster: finis opus coronat." U.S. v. Aluminum Co. of America, 148 F.2d 416, 446 (2d Cir. 1945).

information. In the meantime, the monopolist will continue to benefit from unlawfully acquired advantages.[71]

C. EXPERIENCE WITH ANTITRUST REMEDIES IN DIGITAL MARKETS

These limitations are reflected in the experience with traditional antitrust remedies imposed in digital markets so far, which have largely been ineffective. Google—and to a lesser extent Facebook—have been repeatedly subject to antitrust enforcement in some jurisdictions. In the EU, Google was declared in violation of abuse of dominance law three times between 2017 and 2020.[72] And yet antitrust enforcement has hardly dented Google's dominant position in general search services.

Retributive remedies like fines are insufficient to deter business conduct in ways that increase competition, especially if such fines only relate to the harms caused by the practice in a handful of jurisdictions that bring suit.[73] Recall that for its various antitrust violations, Google paid a total of €8.2 billion in fines to the EU. Even if such fines create a sufficient deterrent to future engagement in illegal conduct, imposing fines does not in itself automatically restore competition if earlier anticompetitive conduct engendered insurmountable entry or expansion barriers.

The restorative remedies imposed so far have also largely been ineffective. Neither the United States nor the EU *Microsoft* cases succeeded in restoring competition.[74] In both jurisdictions, antitrust remedies mandated disclosure of the communications protocols used by Windows for PC to interoperate with other operating systems. The remedies took substantial effort to craft yet attracted no interest from the marketplace.[75] The same happened in the EU *Google Shopping* case, in which the defendant developed an access remedy to

71. *See* SHAPIRO & VARIAN, *supra* note 31, at 1, 13.

72. *See generally* Google Shopping, *supra* note 62; Summary of Commission Decision of 18 July 2018 Relating to a Proceeding Under Article 102 of the Treaty on the Functioning of the European Union and Article 54 of the EEA Agreement (Case AT.40099—Google Android), 2018 O.J. (C 402); Summary of Commission Decision of 20 March 2019 Relating to a Proceeding Under Article 102 of the Treaty on the Functioning of the European Union and Article 54 of the EEA Agreement (Case AT.40411—Google Search (AdSense)), 2019 O.J. (C 369).

73. Besides, these cases suggest that continual exposure to antitrust investigations is not in itself a sufficient remedy to eliminate illegal antitrust behavior, as is sometimes suggested in the antitrust literature. Instead, such behavior might hint that firms take antitrust investigations as a cost of doing business.

74. *See* D.D.C. Consent Decree 2006, 2006 WL 2882808, at 3 § III.E; US Microsoft Decision, *supra* note 27 (illustrating that earlier antitrust actions in the European Union and United States failed to restore competition in light of contemporary antitrust cases).

75. Page, *supra* note 23, at 800–02.

comply with regulatory demands.[76] Google allowed rival comparison-shopping websites to appear in the Shopping Unit displayed at the top of general search pages, on equal footing with its own results. This approach seemed to be consonant with standard practice in the software and high-tech industries.[77] And yet, most observers agree today that the remedy did not significantly increase competition in the market.[78]

A case can therefore be made for the exploration of novel remedies to restore competition. This has been done in the past, as agencies and courts have occasionally experimented with new remedies. In *Paramount Pictures*, for example, the district court initially opposed the government's attempt to mandate that movie distributors divest their controlling stakes in theaters.[79] Instead, it fashioned a mandatory bidding mechanism that allowed theaters to obtain film rights from competing distributors. Similarly, in *Microsoft*, the complex set of remedies applied to Microsoft was more flexible and forward-looking than had been previously tried under U.S. antitrust law.[80]

These possible deficiencies of conventional remedial solutions highlight the need to envision remedial roads not travelled. Such remedies should be sensitive to the characteristics of the digital market in which they are applied. In line with our discussion above, where network effects and scale economies create tipping effects and transaction costs are high, the remedies should focus on restoring competition *for* the market. Such remedies should also attempt to minimize the risk of selecting inefficient technological options. Note, however, that the remedy need not necessarily relate specifically, or solely, to the anticompetitive conduct. Consider the example of unlawful conduct limitation of access to a certain type of data. To restore competition the remedy might need to go beyond prohibiting the continual erection of such access barriers,

76. *See* Bo Vesterdorf & Kyriakos Fountoukakos, *An Appraisal of the Remedy in the Commission's Google Search (Shopping) Decision and a Guide to its Interpretation in Light of an Analytical Reading of the Case Law*, 9 J. EUR. COMPETITION L. & PRAC. 3 (2018).

77. *See* Waller, *supra* note 25 (highlighting how access remedies have become a vital part of litigated cases and settlements in cases involving network industries, telecommunications, broadcasting, software platforms, and other high-technology industries at the forefront of antitrust enforcement).

78. *See* Chee & Waldersee, *supra* note 7.

79. *See* U.S. v. Paramount Pictures Inc., 66 F. Supp. 323, 353 (S.D.N.Y. 1946), *aff'd in part and rev'd in part*, 334. U.S. 131 (1948). Note that the Supreme Court remanded the case to the district court on this point, leading eventually to a vertical divestiture.

80. *See* Hesse, *supra* note 6, at 863. The remedy had a requirement that Microsoft "make available" to developers the protocols that Microsoft's server operating systems use to "interoperate . . . natively." United States v. Microsoft Corp., 231 F. Supp. 2d 144, 192 (D.D.C. 2002). For a critique, see William H. Page, Optimal Antitrust Remedies: A Synthesis (May 17, 2012) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2061791.

to reset the market to the "but for" world. In the following Sections we explore three radical remedies. All three may enable restoration of both competition *in* the market, as well as *for* the market in the extreme situations when that is the case.

III. MANDATORY SHARING OF ALGORITHMS

Algorithms can improve by training on datasets.[81] Generally, the larger and better the dataset, the better the learning.[82] Accordingly, the first radical remedy to consider is a mandatory duty to share improved algorithms trained on large datasets when this was made possible through anticompetitive collection, analysis, or use of data. This remedy can provide a swift tool for restoring competition in some markets while not harming customers by denying them access to the advantages flowing from the use of better algorithms. The uniqueness of this remedy is that it entails sharing the spoils of anticompetitive conduct. In that sense, it is both intuitive and counterintuitive. On the one hand, if better algorithms are a byproduct of unlawful conduct, why not restore competition and increase social welfare by compelling firms to share such algorithms with rivals? On the other hand, this remedy implies acquiescence to the fruit of anticompetitive conduct for the sake of (some) socially beneficial consequences.

This departure from conventional practice requires understanding the ways that algorithms develop comparative advantages, and how artificial barriers to data collection can inhibit the creation of such advantages (A). With this clarified, an antitrust case for a mandatory duty to share improved algorithms can be conceived (B). The remedy is not problem-free (C). Yet in some situations, it remains superior to alternative remedies like data sharing or "unteaching" the algorithm (D).

A. ALGORITHMIC-BASED COMPARATIVE ADVANTAGES[83]

Algorithms are structured decision-making processes that automate computational procedures to generate decisional outcomes based on data

81. We use the term "algorithm" to cover also parts of the code of which it is comprised, including the model from which an algorithm learned through data analysis. Our analysis may also be applied to new machine learning techniques developed by a coder, as long as their development resulted from unlawfully obtained data.

82. David Danks, *Learning*, *in* THE CAMBRIDGE HANDBOOK OF ARTIFICIAL INTELLIGENCE 152 (Keith Frankish, Milton Keynes & William M. Ramsey eds., 2014).

83. This Section builds on Daniel L. Rubinfeld & Michal S. Gal, *Access Barriers to Big Data*, 59 ARIZ. L. REV. 339 (2017), as well as Michal S. Gal & Daniel L. Rubinfeld, *Data Standardization*, 94 N.Y.U. L. REV. 737 (2019) [hereinafter Gal & Rubinfeld, *Data Standardization*].

inputs.[84] Algorithms vary significantly in the computational procedures they use (such as sorting or merging data, finding correlations, etc.) and in their efficiency in achieving the given task (including the time, amount of data, and computer power needed to complete a task).[85]

Algorithms can operate at different levels of abstraction. At the lowest level, all parameters are dictated by the developer in advance ("expert algorithms").[86] For example, an algorithm can be coded in advance to give weight only to data relating to consumers' income and to disregard data regarding their age. Such pre-selection of relevant features enables the algorithm to operate more quickly and also reduces the amount of data needed.[87] Yet such pre-selection is rigid in the sense that changes over time in correlations between different types of data will not be reflected in the algorithmic decision. Alternatively, algorithms can be designed to set or refine their own decision parameters in accordance with the data inputted into them and the decision-making techniques they are coded to perform ("learning algorithms").[88] Learning algorithms employ machine learning—a type of artificial intelligence that enables computers to learn from the data they analyze without the need to define correlations *a priori*.[89] Machine learning is employed in a range of computing tasks where designing and programming explicit algorithms with good performance is difficult or unfeasible (common examples include spam filtering and optical character recognition).[90] Deep

84. *See* THOMAS H. CORMEN, CHARLES E. LEISERSON, RONALD L. RIVEST & CLIFFORD STEIN, INTRODUCTION TO ALGORITHMS 5 (3rd ed. 2009).

85. *Id.* at 5–6. This paragraph largely builds upon Michal S. Gal, *Algorithms as Illegal Agreements*, 38 BERKELEY TECH. L.J. 67 (2019).

86. ORG. FOR ECON. CO-OPERATION & DEV., DATA-DRIVEN INNOVATION: BIG DATA FOR GROWTH AND WELL-BEING 154–57 (2015) [hereinafter OECD, DATA-DRIVEN INNOVATION].

87. *See* Yann LeCun, Yoshua Bengio & Geoffrey Hinton, *Deep Learning*, 521 NATURE 436, 436 (2015).

88. *See, e.g.*, OECD, DATA-DRIVEN INNOVATION, *supra* note 86, at 155. For examples of machine learning already used in algorithms, see Ariel Ezrachi & Maurice E. Stucke, *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, 2017 U. ILL. L. REV. 1775 (2017).

89. Machine learning uses statistical techniques to give computer systems the ability to "learn" from data (i.e., progressively improve their performance without being explicitly programmed). For a detailed description of the statistical frameworks for data learning and analysis, see TREVOR HASTIE, ROBERT TIBSHIRANI & JEROME FRIEDMAN, THE ELEMENTS OF STATISTICAL LEARNING: DATA MINING, INFERENCE, AND PREDICTION (2d ed. 2017).

90. *See* OECD, DATA-DRIVEN INNOVATION, *supra* note 86, at 152–54.

learning is a special type of machine learning based on neural networks.[91] Some algorithms combine the functions of expert and learning algorithms.

Advancements in computer science have increased the ability of algorithms to detect statistical regularities in datasets so as to reveal relevant inter-variable patterns and structures and, in turn, improve our ability to mine valuable knowledge from data. Algorithms can thus create significant advantages in decision-making for descriptive as well as predictive purposes. They offer analytical sophistication that can be achieved by the human mind only with substantial time and effort, if at all.[92]

The performance of algorithms is affected by two main factors. The first is the quality of the data inputs. Data constitute the essential raw material for sophisticated algorithmic decision-making.[93] The best theoretical computational model will only work well if it has the necessary data on which to base its decisions.[94] The second factor is the quality of the algorithm, and in particular, its initial ability to base decisional outcomes on patterns and correlations identified in the data.[95] These factors are often interconnected through a feedback loop: algorithms can fine-tune their decisional parameters based on the error rate of past data outputs, a technique known as backpropagation.

Data properties affect algorithmic performance. For many applications, the quality of outputs is correlated with the volume of the data used in the analysis, as well as the diversity of its sources (variety),[96] its accuracy (veracity),

91. Deep learning offers an alternative paradigm for predicting complex multi-causal phenomena which is based on learning from data representations, as opposed to task-specific algorithms. *See* LeCun, Bengio & Hinton *supra* note 87, at 436.

92. *See* Paul Mozur, *Google's AlphaGo Defeats Chinese Go Master in Win for A.I.*, N.Y. TIMES (May 23, 2017), https://www.nytimes.com/2017/05/23/business/google-deepmind-alphago-go-champion-defeat.html.

93. *See generally* OECD, DATA-DRIVEN INNOVATION, *supra* note 86.

94. *See* Chris Brummer & Yesha Yadav, *Fintech and the Innovation Trilemma*, 107 GEO. L.J. 235, 275–76 (2019). McKinsey estimates that data mining by firms increases operating margins by more than sixty percent. JAMES MANYIKA, MICHAEL CHUI, BRAD BROWN, JACQUES BUGHIN, RICHARD DOBBS, CHARLES ROXBURGH & ANGELA HUNG BYERS, MCKINSEY GLOB. INST., BIG DATA: THE NEXT FRONTIER FOR INNOVATION, COMPETITION, AND PRODUCTIVITY 2 (2011).

95. Other factors may also be relevant, such as the computer's computational power and its ability to store and quickly retrieve data.

96. Data analysis is often characterized by economies of scale and scope, at least up to a point. This implies that the larger and the more varied the dataset, the better the knowledge that can be mined from it. *See* Viktor Mayer-Schönberger & Yann Padova, *Regime Change? Enabling Big Data Through Europe's New Data Protection Regulation*, 17 COLUM. SCI. & TECH. L. REV. 315, 320 (2016).

and its freshness (velocity).[97] The relative importance of each of these characteristics may differ between use cases and application domains.[98] In general, tasks such as identifying patterns, generating predictions, and adapting promptly to rapidly changing circumstances require vast datasets of fresh, varied, and accurate data.[99] Furthermore, the increasing use of deep learning as a data analysis tool "implies a shift towards investigative approaches that use large data sets to generate predictions for physical and logical events that have previously resisted systematic empirical scrutiny."[100] Accordingly, large volumes of diversified data have been recognized as central resources for the provision of both private goods by markets (e.g., in advertising, finance, logistics, or transport) and public goods by the state (e.g., health hazards, terrorist threats, or cybersecurity).[101]

The volume, variety, velocity, and veracity of the data may also affect the quality of the algorithm used for its analysis, due to the algorithm's feedback loop, where the parameters used by the algorithm to make new predictions improve over time as the algorithm learns by analyzing the effects of its past predictions.[102] Accordingly, the better the data, the better the algorithm performs and the better its predictions. The qualities of a dataset can also create positive externalities with respect to other datasets. This is because an algorithm can "learn" from a high-value dataset to perform tasks that can then be performed on different datasets—a process called transfer learning.[103] For example, Facebook was able to improve its facial recognition algorithm by training its algorithm on a vast dataset of pre-labelled photos uploaded to its

97. *See* PRESIDENT'S COUNCIL OF ADVISORS ON SCI. & TECH., EXEC. OFF. OF THE PRESIDENT, BIG DATA AND PRIVACY: A TECHNOLOGICAL PERSPECTIVE 2 (2014); ORG. FOR ECON. CO-OPERATION & DEV., SUPPORTING INVESTMENT IN KNOWLEDGE CAPITAL, GROWTH AND INNOVATION 325 (2013); Mark Lycett, *'Datafication': Making Sense of (Big) Data in a Complex World*, 22 EUR. J. INFO. SYS. 381, 381 (2013).

98. Rubinfeld & Gal, *Access Barriers*, *supra* note 83, at 347.

99. For a discussion on facial recognition algorithms, see PATRICK GROTHER, MEI L. NGAN & KAYEE HANAOKA, NAT'L INST. OF STANDARDS & TECH., ONGOING FACE RECOGNITION VENDOR TEST (FRVT) (2018), https://github.com/usnistgov/frvt/blob/nist-pages/reports/11/frvt_11_report_2018_06_21.pdf.

100. Iain M. Cockburn, Rebecca Henderson & Scott Stern, *The Impact of Artificial Intelligence on Innovation*, *in* THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA 139 (Ajay K. Agrawal, Joshua Gans & Avi Goldfarb. eds., 2019).

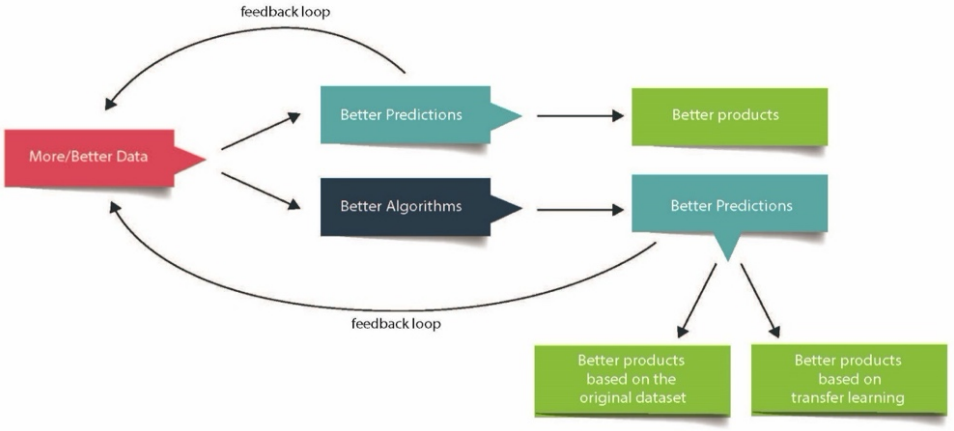
101. *See, e.g.*, OECD, DATA-DRIVEN INNOVATION, *supra* note 86.

102. *See* MAURICE STUCKE & ALLEN P. GRUNES, BIG DATA AND COMPETITION POLICY 170 (2016) (describing this feedback loop in the context of Google's search engine algorithm).

103. *See* Lilyana Mihalkova, Tuyen Huynh & Raymond J. Mooney, *Mapping and Revising Markov Logic Networks for Transfer Learning*, *in* PROCEEDINGS OF THE 22ND CONFERENCE ON ARTIFICIAL INTELLIGENCE 608 (AAAI-07) (2007).

website and tagged by users.[104] The same algorithm could then be used for other tasks such as security cameras. Figure 1 summarizes the benefits that flow from more and better data.

Figure 1: The Effects of Better Data[105]



For our analysis, it is essential to delve into some details of algorithmic learning. At a very basic level, learning algorithms are "shells" of certain actions that need to be tuned to achieve maximum utility from each dataset. Tuning involves both hyper-parameters and parameters. Hyper-parameters are usually determined by an expert before the algorithm is put into use. For example, the algorithm might be set to disregard data that is more than two standard deviations removed from the average of a certain type of data. They are based on prior expertise and the assessment of the initial data. Such expertise can also arise from experience from fine-tuning algorithms to other datasets (transfer learning). Parameters are learned and tuned through the algorithm's learning process from the specific dataset (e.g., the initial setting gave a weight of 2 points to a certain feature, but data from the feedback loop indicated that it should be changed to 2.5 points). Accordingly, as can be seen, the quality of the algorithm is connected to the existence, experience, and quality of the dataset. When we relate below to sharing algorithms, we relate to the sharing

104. *See* Tom Simonite, *Facebook Creates Software that Matches Faces Almost as Well as You Do*, MIT TECH. REV. (Mar. 17, 2014), https://www.technologyreview.com/s/525586/facebook-creates-software-that-matches-faces-almost-as-well-as-you-do.

105. This figure is largely based on Gal & Rubinfeld, *Data Standardization*, *supra* note 83, at 745. Many thanks to Lili Fibish-Schor for creating the illustration.

of not only the basic algorithm but also to its hyper-parameters and parameters.

Also important for our analysis, learning from data is generally characterized by a learning curve where more and better data is beneficial up to a point, after which marginal benefits are small or trivial. The point at which the curve starts to flatten depends on the type of data, the task at hand, and the level of accuracy that is sufficient for the task.[106] To exemplify the implications of this, let us offer the following stylized example. In a given market, the marginal effects of each additional datum on the quality of the algorithm increase significantly until 1M data points. At that point, the algorithm does not learn much from additional data, so that data collection becomes less important. The algorithm can then be applied to a small scale of new data and achieve relatively similar results to those achieved by anyone applying it to the entire dataset.

Finally, and important for our analysis, a sophisticated or efficient algorithm might be able to mine the needed information from lower-quality data.[107] Such superior performance may result from external expert codification or from algorithmic learning based on the data. Where data collection, organization, or storage is costly, the ability to use less data may create significant comparative advantages.

B. ANTITRUST MANDATORY DUTY TO SHARE ALGORITHMS

The first remedy we discuss involves requiring a firm to share a certain algorithm—or parts of its code—with rivals. The remedy targets algorithms which involve learning from unlawfully obtained data or legally obtained data, to which access was illegally prevented from rival firms. It is thus relevant mainly to learning algorithms and less to expert algorithms.[108]

Mandated sharing of algorithms could be relevant in two sets of circumstances. First, a firm might possess superior algorithms as a result of unlawfully excluding rivals from access to training data.[109] Consider, for example, the case of anticompetitive exclusive dealing agreements between an online retail monopolist and merchants. Such agreements limit rivals' access to

106. For diminishing returns to scale in search markets, see Leslie Chiou & Catherine Tucker, *Search Engines and Data Retention: Implications for Privacy and Antitrust* (Nat'l Bureau of Econ. Rsch., Working Paper 23815, 2017), http://www.nber.org/papers/w23815.pdf.

107. *See, e.g.*, Brummer & Yadav, *supra* note 94, at 275–76.

108. It is more relevant to expert algorithms if the developer who designed the expert algorithm also learned from such data.

109. For discussions of unlawful exclusion from access to data, see EU REPORT, *supra* note 1, at 98–108; UK REPORT, *supra* note 2; AUSTRALIAN REPORT, *supra* note 2, at 115; GRAEF, *supra* note 13.

sales data necessary to improve recommendation algorithms, which affect competition in the online retail market. Under the conservative assumption that the performance of recommendations is a relevant dimension of online retail competition, the illegal agreements lead to a restraint of competition potentially vulnerable to prohibition. In the second case, a monopolist might be able to extract more data from users than its rivals by illegally exploiting monopoly power.[110] In both scenarios, unlawfully obtained data enable the monopolist to develop better algorithms and thereby

gain a comparative advantage in the market. A remedy that mandates sharing of what is learned from such data, by sharing the algorithm including its hyper factors, is thus an intuitively appealing way to restore competition by allowing disadvantaged rivals to catch up.

As an example, assume that two firms compete in the provision of algorithms that suggest real-time treatment of diabetes patients. The algorithms improve by learning from data regarding the effects on patients of past suggestions. The dominant company engages in exclusive contracting and places (contractual or technological) limits on patients' ability to transfer their personal data to competitors. Accordingly, the algorithm of the dominant firm learns from the data feedback loop and improves. For example, the data may reveal that a combination of a certain exercise and a certain food might work best in some circumstances. Should transfer learning be relevant, the algorithm's comparative advantages might be all the more significant. Should access to such data be anticompetitively blocked from a competitor, they may

110. Such conduct might be captured under Section 5 of the Federal Trade Commission Act (FTCA), 15 U.S.C. § 45. In 2012, the FTC found that Facebook had engaged in conduct which constituted unfair means of competition by failing to keep its privacy promises. Press Release, Fed. Trade Comm'n, Facebook Settles FTC Charges that It Deceived Consumers by Failing to Keep Privacy Promises (Nov. 29, 2011), https://www.ftc.gov/news-events/press-releases/2011/11/facebook-settles-ftc-charges-it-deceived-consumers-failing-keep. In 2019, the FTC reached a $5 billion settlement with Facebook regarding its data protection breaches involving Cambridge Analytica. Exploitative anticompetitive conduct in data collection was alleged by the German Antitrust Authority in its case against Facebook regarding conditions for third-party tracking. *See* Bundeskartellamt [BKA] [Federal Cartel Office] Feb. 6, 2019, B6-22/16, (Ger.), https://www.bundeskartellamt.de/SharedDocs/Entscheidung/EN/Fallberichte/Missbrauchsaufsicht/2019/B6-22-16.pdf?__blob=publicationFile&v=3. The prohibition was first suspended in a preliminary decision of the court of appeal. *See* Oberlandesgericht [OLG] [Higher Regional Court Düsseldorf] Aug. 26, 2019, VI-Kart 1/19 (Ger.), (https://www.justiz.nrw.de/nrwe/olgs/duesseldorf/j2019/Kart_1_19_V_Beschluss_20190826.html. On appeal, however, the German Federal Supreme Court ruled against Facebook and in favor of the Bundeskartellamt [BKA] [Federal Cartel Office] Jun. 23, 2020, KVR 69/19 (under interim proceedings), https://www.iww.de/quellenmaterial/id/217600. A debate exists over whether such conduct constitutes an antitrust offense. *See, e.g.*, Viktoria H.S.E. Robertson, *Excessive Data Collection*, 57 COMMON MKT. L. REV. 161 (2020).

not be able to compete effectively. Sharing the algorithm which embodies the learning from the data may reset the market game in real time.

Mandatory sharing of an algorithm has five main advantages as a restorative remedy in digital markets. The first is that the algorithm is non-rivalrous and copying costs may be very low. The second advantage relates to its relative immediacy in restoring competition compared to other remedies.[111] Even if rivals could begin to gather the necessary data following the removal of anticompetitive barriers to its collection, they would not be able to mine high-quality information from it until they reached data-related scale and scope economies. Mandating sharing of the algorithm may overcome this barrier. By analyzing their limited data through an algorithm that incorporates learning from big data, rivals are able to benefit from such learning (almost) as if they were able to gather the big data themselves. The shared algorithm can be applied (almost) immediately by rivals on their datasets, as long as certain technological conditions, elaborated below, are met.

Third, mandatory sharing of the algorithm can limit the enjoyment of illegally obtained comparative advantages without harming consumers by prohibiting the use of algorithms that increase consumer welfare. This is no small feat. To see this, compare it to the "but for" conditions that would be sought with a conventional remedy. In a conventional situation, the antitrust infringer would have to behave as if their algorithm had not improved. Under mandated sharing, all market players enjoy equal access to state-of-the-art technology. The remedy thus restores a level playing field by eliminating unlawful comparative advantages, while widely disseminating the benefits of superior technology.[112] Furthermore, by sharing the fruits of the unlawful conduct, the remedy is indirectly connected to the unlawful conduct.

Fourth, mandatory sharing of the algorithm does not require continual supervision. It is a one-time remedy. Furthermore, in cases in which the improvements to algorithms are a direct result of unlawful conduct, antitrust agencies and courts need not spend time designing licensing terms. This is because there is no reason to allow the antitrust infringer to benefit from

111. For a discussion of the importance of speed in restoring competition, see STIGLER REPORT, *supra* note 2, at 80.

112. As noted in the STIGLER REPORT, "[a] data advantage over rivals can enable a company to achieve a virtuous circle of critical economies of scale leading to network effects, and a competitive balance in its favor, leading to the gathering of yet more data. A new entrant is likely to experience this in reverse—a vicious cycle—as it fails to surmount the entrance barrier." *Id.* at 40.

licensing fees and to spend time on their optimal specification in terms of their effects on motivation to innovate.[113]

Finally, it creates better conditions for restoring competition *for* the market in some circumstances. In digital markets prone to tipping,[114] a winner generally takes all or most of the market,[115] so that incumbency advantages are hard to match.[116] Mandating that firms share algorithms that benefited from illegally obtained economies of scale and scope in data collection and analysis may enable rivals to overcome at least some data-based first-mover advantages.[117] This might be especially important in markets where data-based advantages are the main sources of comparative advantage. Should the market tip again, a more efficient competitor will then have a better chance of winning the new competition.

The virtues of mandatory sharing are not unconditional. First, the algorithmic learning must have resulted from the collection of data to which rivals were denied access due to anticompetitive conduct, or where the data collection imposed anticompetitive conditions on users. Observe that the data from which the algorithm learned need not be exactly the same data that a rival would have collected absent the anticompetitive conduct. Such a requirement would render the remedy almost meaningless, as in most cases rivals do not need the exact same data in order to compete. Rather, they need a comparable dataset. To illustrate, assume that a monopolist's exclusionary tactics prevented a rival from accessing websites that would have enabled the latter to collect unique information on users—information deemed essential for its operations. The monopolist's dataset need not necessarily relate to the specific data that the rival would have analyzed, yet it should reveal similar information and lead to similar knowledge from a similar set of new data.

Second, the algorithm's functions must be relevant and beneficial to the competitive potential of rivals.[118] There is no point in sharing an inefficient algorithm that does not create comparative advantages or sharing the

113. Unlike in cases of disclosure remedies where a dominant firm is entitled to licensing revenue in exchange for the transfer of lawfully acquired technology to competitors, here antitrust agencies and courts need not spend much time designing licensing terms.

114. *See* STIGLER REPORT, *supra* note 2, at 29.

115. *See id.* at 40.

116. *See id.*

117. Some scale or scope economies or network effects may not be data-related, such as those derived from belonging to a popular social network or using a service (e.g., a restaurant guide) which automatically interconnects with other services (e.g., online maps). Where such effects are significant, tipping might not be prevented.

118. We do not require indispensability of the algorithm to rivals' ability to compete, as would have been required under the essential facilities doctrine. *See* GRAEF, *supra* note 13.

algorithms with firms that rely on distinct algorithmic and non-algorithmic capabilities to compete in the relevant market. Mandatory sharing might be more efficient where the main entry barriers into market are data-driven and where other entry barriers—resulting, for example, from digital ecosystems—are not prohibitive. Also, the duty to share algorithms should generally benefit only rivals whose operations were significantly and adversely affected by the anticompetitive conduct and which had a reasonable chance of succeeding in the market absent the anticompetitive conduct. In cases where the anticompetitive conduct prevented any rival from entering the market, it is suggested that the algorithm be shared with potential competitors who can prove that they would likely benefit from it to create competitive pressure in the market. Sharing with additional rivals should cease once competition starts to gain critical mass.

Third, rivals should have access to data, data structures, and infrastructures on which to run the algorithm. This technological condition requires, for example, that the necessary features of the algorithm's data input fit a rival's dataset (e.g., if the required input in a health-related algorithm is limited to patients' temperature, the rival's data must relate to patients' temperature rather than to other parameters like blood pressure). In this regard, it is also important to realize that mandating sharing of an algorithm might not restore a competitive level playing field in all circumstances. Even if the shared algorithm incorporates all learning from past data outputs, an algorithm's feedback loop is continuous. Therefore, if the monopolist has a larger or higher-quality dataset than its rivals, the addition of new data might enable the monopolist's algorithm to find new and more accurate correlations than rivals will find with their lower-quality datasets. The monopolist might therefore remain at a competitive advantage, though a less significant one. In such cases, an additional mandatory duty to share data might be needed to effectively restore competition.

Fourth, rivals need to know the algorithm's function, the features that it uses, and the meaning of output values. To borrow from Douglas Adams, if the algorithm produces the output 42, rivals need to know that it answers the question "What is the meaning of life, the universe, and everything."[119] Where possible, the causal or informational relationships underpinning the patterns and structures found by the algorithm should be illuminated.[120] To ensure that

119. DOUGLAS ADAMS, A HITCHHIKER'S GUIDE TO THE GALAXY (1979).

120. One issue with deep learning is its inability to provide the explanation behind found correlations (this is commonly known as the "black box problem"). However, some advanced algorithms can identify causality. *See, e.g.*, Rainer Opgen-Rhein & Korbinian Strimmer, *From*

the correct algorithm was indeed shared, indirect verification may be used. In some situations, experts appointed by the antitrust decision maker can perform such verification by applying the algorithm in test cases to the monopolist's and rivals' datasets and comparing the results. Last, the shared algorithm must be interoperable with rivals' datasets. In some cases, the algorithm will have to be changed to fit a new data format used by the rival (e.g., it may need to analyze data collected every five minutes instead of every ten minutes), or the data will have to be adapted in order to be usable by the algorithm. So long as either task can be performed with reasonable speed and cost, this condition will be fulfilled.

Fifth, not all algorithms are seamlessly portable, as some might display a high degree of asset specificity. For example, a self-driving cars' algorithm for bicycle detection might be specifically designed to interact with manufacturer-specific technological systems that control key functions like braking, steering, and warning. In such cases, it might be difficult for competitors to benefit from the algorithm.

As shown, under some conditions mandatory sharing of algorithms can provide an effective restorative remedy. Mandatory sharing of algorithms has five attractive properties over the remedies conventionally applied in digital markets. At the same time, its application may also raise some problems, to which we turn next.

C. PROBLEMS RAISED BY MANDATED SHARING OF ALGORITHMS

Various problems arise from a mandatory duty to share algorithms as a remedy in antitrust cases. The first concerns incentives. Many algorithms are firms' proprietary assets. Though they are often not eligible for strong intellectual property protection, algorithms are considered know-how or trade secrets. Duty of disclosure might thus reduce firms' incentives to invest in data collection and analysis through algorithms in the first place. This concern is in fact the main reason why antitrust agencies and courts are cautious in mandating compulsory licensing of patents.[121] Yet in our restricted antitrust

Correlation to Causation Networks: A Simple Approximate Learning Algorithm and Its Application to High-Dimensional Plant Gene Expression Data, 1 BMC SYS. BIOLOGY 37 (2007).

121. Compulsory licensing was employed to remedy some antitrust violations during the mid-twentieth century. Many observers consider that compulsory patent licensing was a highly successful remedy in two high-profile cases. Compulsory patent licensing by the Bell System (AT&T) in 1956 fostered innovation and arguably made the semiconductor industry possible, and the Xerox settlement in 1975 spurred competition, entry, and innovation in plain paper copiers. At the same time, there is a legitimate claim to be made that the first case overreached by leading to the dismantlement of Bell Labs and that the second case commoditized the

scenarios, the algorithm's comparative advantages result from illegal conduct rather than competition on the merits.[122] Chilling effects on the incumbent are therefore irrelevant, as long as the conditions for imposing liability are prospectively clear. Rather, by limiting the ability of the infringer to enjoy ill-gotten gains, the remedy limits incentives to engage in unlawful conduct. The remedy might, nonetheless, affect the incentives of other firms to invest around the algorithm. Yet this effect should be minimal, as long as mandatory sharing is imposed in a restricted set of antitrust cases. To that end, the algorithm should only be disclosed to a limited number of firms who can demonstrably establish that they hold the capabilities required to jumpstart competition.

The second problem concerns administrability. Part of the algorithm's comparative advantage might be based on the monopolist's lawful conduct. The hard questions are then to what extent the algorithm's comparative advantage resulted from lawful conduct and whether this advantage can be separated from illegally obtained benefits. A relatively easy case arises when only illegally obtained data was used to improve the algorithm's learning (and therefore performance) in a very specific task, which can be quite easily separated from other tasks performed by the algorithm. In such a case, only the illegally gained learning should be shared. But this is rarely the case, as more often an algorithm will learn based on both legally and illegally obtained data. If the remedy cannot be technologically limited to sharing the incremental learning resulting from the violation, the question arises whether justification exists for imposing a more expansive duty to share. Sharing might be justified where the monopolist maintained its position by engaging in significantly harmful long-term and systemic anticompetitive conduct, or where the benefits from the lawfully obtained data are relatively insignificant. Indeed, a rule which prevented courts from mandating sharing in all circumstances where data was combined would make it easy for monopolists to avoid such sharing by simply adding a small amount of legally obtained data to their dataset.

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domestic photocopying industry and led to a new division of labor that predominantly benefited Asian producers of plain paper copying systems. On claims that the AT&T remedy harmed research at Bell Labs, see David J. Teece, *Next-Generation Competition: New Concepts for Understanding How Innovation Shapes Competition and Policy in the Digital Economy*, 9 J.L. ECON. & POL'Y 97 (2012). On the mixed record of the Xerox settlement, see William E. Kovacic, *Designing Antitrust Remedies for Dominant Firm Misconduct*, 31 CONN. L. REV. 1285 n.84 (1999).

122. For discussion of the effects of antitrust rules on incentives to innovate, see Jonathan B. Baker, *Evaluating Appropriability Defenses for the Exclusionary Conduct of Dominant Firms in Innovative Industries*, 80 ANTITRUST L.J. 431 (2016).

Similarly, sharing the algorithm and documenting its functions might be technologically difficult. In the *Microsoft* case, for example, the matter of accurately documenting all the communication protocols for connecting servers with desktop PCs was difficult and slow.[123] The Technical Committee, an expert three-person group whose task was to monitor compliance with the decree, undertook to assist Microsoft.[124] It eventually employed around fifty engineers and hired outside consultants. The EU experience was also fraught with problems and took much longer than directed.[125] Accordingly, a cost-benefit assessment should be conducted before such sharing of an algorithm is mandated. Nonetheless, in some cases, a specific piece of code might be easily distinguished and explained. Furthermore, where machine learning is concerned, causality need not be explained, and correlations flow from the use of the algorithm. Moreover, sharing is a one-time remedy that once administered does not need to be followed up. In any case, computer and data scientists should be employed by the enforcer to ensure all relevant technological aspects are analyzed and that the most up-to-date algorithms are shared.[126] This is especially important where continuous data feeds continue to improve the algorithm.

A third problem is the risk of anticompetitive coordination. If the remedy is applied in an oligopolistic market, then use of a similar algorithm by competitors might lead to express or tacit collusion.[127] Of course, the use of a similar algorithm by competitors will not necessarily reduce competition. Much depends on the function of the algorithm and other parameters that affect market players' decisions. If, for example, the algorithm simply performs the same function for all rivals efficiently, but the data inputted by rivals is different, then coordination will be more difficult to achieve.[128] To reduce

123. ANDREW GAVIL & HARRY FIRST, THE MICROSOFT ANTITRUST CASES 239–41 (2014).

124. *Id.* at 239.

125. *See id.* at 249.

126. Such considerations were considered in other cases as well. For example, in MSC, the FTC determined that the sale of illegally acquired software, which was shelved and thus became obsolete, would constitute meaningless relief and mandated the acquirer to license new generation software the competitors. The acquirer was allowed to select a company to license its software, and, depending upon the FTC's view of the competitive viability of the chosen firm, mandate the licensing to a second firm as well. MSC.Software Corporation (Docket no. 9299), FED. TRADE COMM'N (June 10, 2003), https://www.ftc.gov/enforcement/cases-proceedings/0010077/mscsoftware-corporation.

127. This scenario resembles, in some ways, the hub and spoke scenario explored by ARIEL EZRACHI & MAURICE E. STUCKE, VIRTUAL COMPETITION (2016).

128. *See* Michal S. Gal, *Algorithms as Illegal Agreements*, 34 BERKELEY TECH. L.J. 67 (2019). Yet much depends on the content of the data. Should all competitors apply different—yet

anticompetitive coordination risks, the process of sharing the algorithm should be conducted in a way that reduces direct contact between the rivals, relying instead on third-party intermediaries and ensuring that sharing is a one-time event.

A fourth, and last problem, is counterproductive consumer welfare effects. There are two issues here. The first issue is that some dominant algorithms might entail by their very nature a degree of harm to consumer welfare. This might be the case, for instance, when algorithms maximize user attention by prioritizing sensationalistic, unauthentic, and hateful content. In this case, the mandatory sharing of such an algorithm, and increased competition that follows, will entail more duplication of the "bad" algorithm. In turn, algorithmic competition could lead to more "bad" output not less. In other words, it is not a given that more competition between algorithms will lead to less clickbait. The second issue is different, though connected. In some circumstances, a degree of variety in algorithms is desirable. Here, for instance, we might want algorithmic quality differentiation. However, a problem is that sharing at the algorithmic level might short-circuit differentiation by making the shared algorithm the dominant design.

D. ALTERNATIVE REMEDIES? DATA SHARING AND "UNTEACHING" THE ALGORITHM

A more straightforward remedy in a case of anticompetitive exclusion or appropriation of data is a mandatory duty to share data, not algorithms.[129] Some traits of data ease the application of such a remedy. Data are non-rivalrous. One person's use of data does not, as a general rule, impact the ability

representative—samples of the relevant data to a similar algorithm, they would all reach similar outcomes.

129. The sharing of data which is essential to rivals' operations has been explored in the literature, mainly though the potential application of the essential facilities doctrine. *See, e.g.*, GRAEF, *supra* note 13. In some rare cases an obligation to share data has been imposed through antitrust laws in order to advance competition. One example involves the decision of the French competition authority, the Autorité de la Concurrence, in *GDF Suez*. There, the monopolist enjoyed a data-based advantage which derived from its previous exclusive access to data on customers obtained within the framework of its former government-created monopoly status. It was ordered to give competing market players access to certain data about its customers (e.g., names, addresses, telephone numbers and consumption profiles), which were deemed essential to enable rivals to compete effectively with it. Autorité de la concurrence [Competition Authority] Décision 14-MC-02 du 9 Septembre 2014 relative à une demande de mesures conservatoires présentée par la société Direct Energie dans les secteurs du gaz et de l'électricité, paras 169–74, http://www.autoritedelaconcurrence.fr/pdf/avis/14mc02.pdf. For a relatively similar Belgian case, see Vikas Kathuria & Jure Globocnik, *Exclusionary Conduct in Data-Driven Markets: Limitations of Data Sharing Remedy*, 8 J. ANTITRUST ENF'T 511(2020)

of others to use the same data.[130] Data are replicable at very low marginal cost. And data are divisible, so they can be integrated with other data, whether collected by the same entity or by another.[131]

Data sharing, however, has four main disadvantages relative to sharing the data-based algorithmic learning. The first relates to the technological difficulties involved in data portability and interoperability. It might take rivals time to study the data and organize it in a way that would enable their algorithm to learn from the data, thereby lengthening the time that the monopolist enjoys their illegally gained position and its fruits. Indeed, once the data are transferred, receivers will need to determine which part(s) of the transferred data are relevant, make sense of the meta-data (i.e., what each datum signifies), and integrate the new data into their datasets. The integration of huge amounts of data into one high-quality dataset is complex and raises synchronization and search optimization issues.[132] The challenge is to integrate data that are not necessarily similar in source or structure, and to do so quickly and at a reasonable cost.[133] In some cases such costs might be sufficiently high to prevent use of the data by the rival. In others they might take quite long to overcome, thereby lengthening the time that the infringer enjoys his unlawfully acquired comparative advantage.

The second disadvantage is administrability. Data sharing may be fraught with problems relating to the design of an access regime, including the scope of the data transfer and the conditions for data portability and interoperability.[134] Bilateral negotiations under the supervision of arbitrators, trustees, or technical experts might help, but in cases of disagreement, agencies and courts might not be able to avoid costly data sharing disputes involving difficult questions about, for example, the scope of the data transfer or the conditions for data portability and interoperability.[135] Furthermore, it is possible that part of the relevant data was not stored by its user and thus obviously cannot be shared.

The third disadvantage is more fundamental and harder to overcome: the sharing of data might be prohibited by other laws, mainly those that protect

130. *See* STUCKE & GRUNES, *supra* note 102, at 44.

131. *See* FED. TRADE COMM'N, DATA BROKERS: A CALL FOR TRANSPARENCY AND ACCOUNTABILITY 14 (2014).

132. *See* Gal & Rubinfeld, *supra* note 83; EU REPORT, *supra* note 1, at 74.

133. *See The 6 Challenges of Big Data Integration*, FLYDATA, https://www.flydata.com/the-6-challenges-of-big-data-integration (last visited Mar. 20, 2019).

134. *See* EU REPORT, *supra* note 1, at 109; Gal & Rubinfeld, *Data Standardization*, *supra* note 83.

135. *See* EU REPORT, *supra* note 1, at 109; Gal & Rubinfeld, *Data Standardization*, *supra* note 83.

personal data, such as the Californian Consumer Protection Act (CCPA).[136] Accordingly, sharing personally identifiable information without a legal basis under data protection laws, even if it is essential for competition, would constitute an infringement. The main basis for sharing is user consent, which will most likely be difficult to obtain. Data protection considerations will most likely override antitrust considerations.[137] Where these limitations are easy to overcome, data sharing might be a viable option. Sharing of the algorithm might under some circumstances also infringe data protection laws.[138] To illustrate, assume that an algorithm was trained on a dataset containing legally obtained personal information, which enables the algorithm to indirectly identify individuals by using correlations.[139] This type of learning, if used on the datasets of the monopolist's rivals, might enable them to also identify individuals, thereby increasing the potential for harm through breaches of data protection. Yet such infringements are less likely than those resulting from sharing the data itself. In this regard it is noteworthy that different levels of data protection exist in different jurisdictions and even between states. The CCPA, which to a large extent follows the European Union's General Data Protection Regulation (GDPR), is much more restrictive with regard to the use of personal data relative to data protection laws adopted in all other states. This implies that remedies imposed on international firms, which apply similar

136. For a recognition of this limitation, see EU REPORT, *supra* note 1, at 7–10.

137. For a European example, see European Commission, Case M.8124—Microsoft/ LinkedIn, Commission decision of 6 Dec. 2016, para. 255 ("Microsoft is subject to European data protection laws which limit its ability to undertake any treatment of LinkedIn full data. . . . [T]he Commission notes that the newly adopted GDPR . . . may further limit Microsoft's ability to undertake any treatment of LinkedIn full data by strengthening the existing rights and empowering individuals with more control over their personal data (i.e., easier access to personal data; right to data portability; etc."); *see also* European Commission, Case M.8180— VERIZON/YAHOO, Commission decision of 21 Dec. 2016, para. 90. (stating that any combination of the said datasets could only be implemented to the extent allowed by applicable data protection rules); European Commission, Case M.8251 BITE/TELE2/ TELIA LIETUVA/JV, Commission decision of 19 Jul. 2017, para. 87.

138. It might also infringe intellectual property laws, but as discussed below, such laws should not be given precedence when the protected data was gained by illegal conduct. For an argument that justifies such use from within the intellectual property laws themselves, see Mark A. Lemley & Bryan Casey, *Fair Learning* (Jan. 30, 2020) (unpublished manuscript), https://ssrn.com/abstract=3528447 (arguing that copyright law's fair use doctrines should permit copying of works for non-expressive purposes, such as training algorithms).

139. To illustrate, in one case DNA tests performed by a family historian revealed that an uncle had an extramarital daughter without the uncle submitting any information. Amy Dockser Marcus, *DNA Testing Creates Wrenching Dilemmas for the Family Historian; 'I Am Sorry My Doing Genealogy Has Opened up Pandora's Box'*, WALL ST. J. (July 20, 2020, 12:01 AM), https:// www.wsj.com/articles/dna-testing-creates-wrenching-dilemmas-for-the-family-historian-11563595261; *see also* STIGLER REPORT, *supra* note 2, at 11 n.15 (citing the same example).

algorithms globally, should not disregard potential infringements of the most stringent laws in countries where the monopolist or its rivals conduct significant business. This raises a host of fascinating issues relating to what norms should govern the data protection levels required from international firms—issues which go well beyond the scope of this Article.[140] The question is further complicated by the fact that the scope of reach of such laws often extends far beyond the geographic borders of their jurisdictions.[141] Yet many algorithms will not have properties that infringe data protection laws—for example, when the algorithms use non-personal data.

Where necessary to restore competition, data sharing and algorithm sharing can be combined.[142] Observe, however, that where economies of scale in data mining have been largely exhausted, there is no need to share the dataset on which the algorithm learned to enjoy the learning. Furthermore, the competitor can create a new dataset that complies with the requirements of the data inputted into the algorithm and need not ensure interoperability with an existing one.

Instead of requiring firms to share a given algorithm, might it be better to "unteach" it? In some cases, it might be possible to teach the algorithm again based only on legally obtained data. Yet this might be possible only if the illegally obtained data on which the algorithm was taught to perform a certain function is known and available and can be easily separated from the dataset. If the illegally obtained data is part of a larger dataset and cannot be identified in retrospect, this is not an option. Also, unteaching the algorithm might not only be costly and time-consuming. It might also negatively affect the internal balance with other parts of the algorithm's decisional process, thereby potentially harming the business model of the monopolist and limiting his ability to enjoy comparative advantages that were legally obtained. Furthermore, such a change could produce negative externalities in other

140. A similar question arises with regard to issues such as freedom of speech norms to be applied by firms like Facebook and its subsidiary YouTube, especially if their services cannot be segregated by geographical borders. This question has become more important following the ECJ ruling that Member States can order platforms to remove defamatory information globally. Case C-18/18 Glawischnig-Piesczek v. Facebook Ireland Ltd. (Oct. 3, 2019).

141. Christian Peukert, Stefan Bechtold, Michail Batikas & Tobias Kretschmer, *European Privacy Law and Global Markets for Data* (2020) (unpublished manuscript), https://doi.org/10.3929/ethz-b-000406601.

142. This might be the case, for example, where exclusionary conduct has erected high barriers to data collection which may take time to overcome. Antitrust enforcers have mandated sharing, and even sale, of datasets in the past. *See, e.g.*, Dun & Bradstreet Corporation (Docket no. 9342), FED. TRADE COMM'N (Sept. 10, 2010) (mandating the sale of a dataset which was obtained through an illegal merger).

markets. A similar argument was recognized by the Department of Justice in *Microsoft*: one of the reasons for not ordering code removal was that independent software vendors had continued to write software that relied on Window's code and forced removal would have disrupted their business.[143] Unteaching the algorithm also imposes on the antitrust infringer on-going technological obligations which might be difficult to monitor by an agency or court.[144] In addition, simply unteaching the algorithm might still enable the monopolist to enjoy some of the fruits of his anticompetitive actions if his current products and services already incorporate such learning. Last, and most importantly, unteaching the algorithm might harm consumer welfare by removing from the market state-of-the-art technology. In comparison, a duty to share the algorithm is a Pareto improvement because it makes everyone better off, without making anyone (including the incumbent) technologically worse off.

In short, and to conclude this Section, mandatory sharing of an algorithm whose creation benefited from anticompetitive conduct holds potential to restore competition in some circumstances, while preventing antitrust infringers from continuing to enjoy unlawful gains from such conduct. In some circumstances, sharing the algorithm is superior to sharing data or unteaching the algorithm.

Finally, it is also noteworthy that from a theoretical point of view, sharing the algorithm is in line with much of traditional antitrust, which may mandate the infringer to share the comparative advantages of his anticompetitive act in order to level the playing field.[145] Accordingly, it can be argued that it is not radical but rather the next logical step in antitrust remedial implementation. Furthermore, in some cases algorithms have already been ordered to be shared. The *Microsoft* case is a known example in which the EU mandated algorithms relating to the protocols of server communications be shared with rivals.[146] And closer to us, Facebook unsuccessfully tried to settle an FTC antitrust investigation by offering to license access to its code and social graph to third

143. *See* GAVIL & FIRST, *supra* note 123, at 248 n.43.

144. Such on-going obligations are more likely if the monopolist's current products and services already incorporate such learning.

145. Sharing as a remedy should be distinguished from non-sharing as a basis for liability, as in the case of refusal to deal. Accordingly, the conditions imposed on the latter do not necessarily carry on to the former.

146. For an analysis of this case, see William H. Page & Seldon J. Childers, *Bargaining in the Shadow of the European Microsoft Decision: The Microsoft-Samba Protocol License*, 102 NW. U. L. REV. COLLOQUY 332 (2008). Another example involves the FTC case involving MSC, *supra* note 126.

parties so they could create their own version of a social network.[147] Nonetheless, as far as we know, the algorithms that were required to be shared were expert algorithms, rather than learning algorithms, and did not learn from illegally obtained data. Accordingly, our suggested remedy goes one step further.

IV. SUBSIDIZATION OF A COMPETITOR

The second radical remedy consists in subsidizing a competitor so as to reintroduce competition following an antitrust infringement. Antitrust fines provide obvious resources to subsidize a competitor, though incentive problems might support the use of other financial arrangements. This Part sketches out a possible antitrust case for a subsidization remedy in digital markets (A). It then delineates strict conditions for its applicability (B). The Part closes with a discussion of outstanding problems raised by antitrust subsidies in digital markets (C).

A. ANTITRUST CASE FOR SUBSIDIZATION OF A COMPETITOR IN DIGITAL MARKETS

Conventional economics generally views government subsidies as anathema to free enterprise and competitive markets.[148] Government subsidies come with a host of negative effects, including protectionism, capture, inefficient regulatory competition, and fiscal deficits. Today, government subsidies are often associated with outmoded theories like mercantilism and protectionism and subject to legal restrictions in international free trade agreements.[149] Furthermore, in some jurisdictions, like the EU, antitrust laws per se proscribe subsidies that are selectively targeted at specific firms (as opposed to horizontal subsidies) due to their distortive effect on competition.[150] Yet a limited economic case for subsidies is recognized in some

147. *See* Tony Romm & Elizabeth Dwoskin, U.S. vs. Facebook*: Inside the Tech Giant's Behind-the-Scenes Campaign to Battle Back Antitrust Lawsuits*, WASH. POST (Dec. 22, 2020), https://www.washingtonpost.com/technology/2020/12/22/facebook-antitrust-lobbying-settlement/.

148. By "subsidies," we mean direct monetary transfers that target specific firms, excluding tax concessions, equity participations and soft loans, as per the standard definition. *See* Robert Ford & Wim Suyker, *Industrial Subsidies in the OECD Economies* (Org. for Econ. Co-operation &. Dev. Econ. Dep't Working Paper No. 74, 1990), https://www.oecd-ilibrary.org/docserver/062357858637.pdf?expires=1595698998&id=id&accname=guest&checksum=E522A23354456A77CB2AE3E8D04319DC.

149. For an overview of the legal regime of subsidies, see Alan O. Sykes, *Regulatory Protectionism and the Law of International Trade,* 66 U. CHI. L. REV. 1, 10–13 (1999).

150. Article 107 of the Treaty on the Functioning of the European Union, 2008 O. J. 115, 0091–0092.

situations, such as when markets undersupply essential goods or in response to external shocks when supply is inelastic and market-driven adjustment is inefficient.[151]

This background should impart caution to any discussion of government subsidies as a potential antitrust remedy. Nonetheless, we argue that in unique situations, targeted subsidies can be used to restore competition. Subsidization of a maverick firm was suggested by one of us in the context of traditional oligopolistic markets to deal with oligopolistic coordination.[152] As elaborated below, this idea can be extended to cases where social welfare would benefit from the introduction or strengthening of a competitor.[153]

Indirect subsidies as part of an antitrust remedy have been applied in the past, albeit in rare cases. In *Alcoa*, the court found that the disposal of government-owned plants leased to Alcoa would restore "free independent private enterprise…discourage monopolistic practices [and] strengthen and preserve the competitive position of small business concerns in an economy of free enterprise."[154] It, therefore, mandated an ad hoc government committee to sell the plants.[155] The greatest part of the plants were sold to Alcoa's competitors at a discount.[156] The jury is still out on whether the *Alcoa* indirect

151. *See generally* Russell D. Roberts, *Financing Public Goods*, 95 J. POL. ECON. 420 (1987); *see also* Warren F. Schwartz & Abraham L. Wickelgren, *Optimal Antitrust Enforcement: Competitor Suits, Entry, and Post-Entry Competition*, 95 J. PUB. ECON. 967 (2011) (arguing that competitor antitrust suits provide a subsidy for entry or continued operation in a market, partially because of treble damages, and may counteract some anticompetitive conduct).

152. Michal S. Gal, *Reducing Rivals' Prices: Government-Supported Mavericks as New Solutions for Oligopoly Pricing*, 7 STAN. J.L., BUS. & FIN. 73 (2001). On the oligopoly problem, see Nicolas Petit, *The Oligopoly Problem in EU Competition Law*, *in* HANDBOOK ON EUROPEAN COMPETITION LAW 259 (Ioannis Lianos & Damien Geradin eds., 2013).

153. This idea can also be extended to oligopolistic markets that have been cartelized in order to move the industry from the collusive oligopoly to the more competitive one which would have existed absent long-term effects of the cartel. This may be the case where market conditions created by the cartel enable oligopolists to continue to enjoy supra-competitive profits by engaging in oligopolistic coordination (e.g., by continuing to use the cartel's prices as a benchmark). Some studies show that cartel overcharges may continue to affect some markets even after the cartel is prohibited. *See, e.g.*, John M. Connor, *Global Cartels Redux: The Amino Acid Lysine Antitrust Litigation*, *in* THE ANTITRUST REVOLUTION (John E. Kwoka & Lawrence White eds., 2008, 5th ed.); John M. Connor & Yuliya Bolotova, *Cartel Overcharges: Survey and Meta-Analysis*, 24 INT'L J. INDUS. ORG. 1109 (2006). In such settings, subsidizing one firm so that it reduces its prices may help restore competition and limit the ability of oligopolists to continue enjoying the long-term fruits of their anticompetitive conduct.

154. U.S. v. Aluminum Co. of America, 148 F.2d 416, 446 (2d Cir. 1945).

155. Herbert Roback, *Monopoly or Competition Through Surplus Plant Disposal: The Aluminum Case*, 31 Cornell L. Rev. 302, 302-03 (1946).

156. Spencer Weber Waller, *Story of Alcoa: The Enduring Questions of Market Power, Conduct, and Remedy in Monopolization Cases*, *in* ANTITRUST STORIES 139–40 (Eleanor Fox & Daniel Crane eds., 2007).

subsidy achieved its stated economic purpose of restoring a competitive structure in aluminum markets.[157] Yet *Alcoa* suggests that a selective subsidy award has been deemed an administrable antitrust remedy. Furthermore, antitrust agencies sometimes use fines levied on infringers to help support rivals harmed by such conduct.

The suggestion here is that in some situations, selective and time-limited subsidies can be an effective tool for restoring competition in digital markets by moving the market closer to what would have existed absent the exclusionary conduct. Indeed, anecdotal evidence exists that government support for digital firms has been successfully practiced. As is widely known, the Chinese tech firms Alibaba, Tencent, and Baidu have gained comparative advantages through indirect support from subsidies, market access restrictions, and government-directed central coordination.[158]

Two goals could potentially motivate an antitrust decision maker to support the subsidization of competitors in digital markets. The first is commoditization. By sponsoring the entry or expansion of a substitute digital service, competition might be recreated in the market, ultimately dissipating monopoly rents. Consider the following example: three firms, A, B, and C, operate in a market. A engages in unlawful exclusionary conduct, leading to the exit of B and C. The exclusionary conduct also enables A to enjoy lasting high entry barriers like switching costs, network effects, or choice stickiness, such that potential competition from rivals is fraught with difficulty even after a finding of antitrust liability. A subsidy might allow the beneficiary to overcome at least some of these entry barriers and bring some competition to the market. Furthermore, the decision maker might require the subsidized firm to set its prices or trade terms below current levels. The incumbent will need to follow its lead or lose market share. This proposal allows rivals to compete vigorously on the merits. No firm is forced to act in a manner that is against its incentives, and there is no ongoing governmental intervention except to

157. *See* Robert W. Crandall & Clifford Winston, *Does Antitrust Policy Improve Consumer Welfare? Assessing the Evidence*, 17 J. ECON. PERSP. 3, 10 (2003). Crandall and Winston offer a mixed assessment of the efficiency of the remedy, observing that in 1955, "Alcoa's market share was less than half of what it was when the government filed its 1937 lawsuit, yet its output was more than four times greater"; but noting also that "when annual demand for aluminum grew in the 1940s and 1950s to more than 1.25 million tons, it is quite likely that more firms would have entered the market even without government assistance." *Id.*

158. *China's Communist Party Will Adapt as Economy Develops*, OXFORD ANALYTICA: EXPERT BRIEFINGS (November 11, 2019). The briefing discusses the Chinese government's carrot-and-stick support for domestic firms through "procurement contracts, subsidies and policy support."

check the price or trade terms set by the subsidized firm. In some situations, it might be best to subsidize more than one new competitor.

Subsidizing a supplier of a substitute product or service has clear upsides. If successful, it introduces direct competition into the market. Furthermore, in the simple case, it reduces informational asymmetry problems that complicate the specification of contracts between governments and firms.[159] The antitrust decision maker need not specify a performance level in exchange for the subsidy. The contract must only order the subsidy recipient to replicate the monopolist's service and set terms and conditions which are competitive.

But this remedy also has obvious limitations. Monopolies that benefit from substantial network effects or economies of scale and scope that lead to winner-takes-most effects are difficult and costly to challenge. The anecdotal evidence is limited but disconcerting. In 2006, France and Germany invested €199 million in *Quaero*, a search engine project led by the private firm Thompson aimed at creating a European rival to Google—an attempt that failed.[160] Similarly, in 2008, the EU allocated €2 million per year to *Europeana*, a European digital library destined to stop the ascendancy of Google Books.[161] Failing to reach critical mass, the project was repurposed as a platform for technical cooperation between European countries.[162] In 2012, France tried to develop a sovereign cloud. It paid €550 million to new players CloudWatt and Numergy in an effort to create alternatives to emerging U.S. competitors.[163] Both projects were recently abandoned, and the capabilities developed were absorbed by domestic telecommunications incumbents. In all cases, a plausible conjecture is that the subsidies might have been too low to create marketplace rivalry. Likewise, Microsoft committed billions of dollars over a long period to build its search engine, Bing.[164] It even launched a rewards program that paid

159. For an overview, see generally Jean Tirole, *Market Failures and Public Policy*, 105 AM. ECON. REV. 1665 (2015).

160. *See Charlemagne: The Perils of Project Mania*, ECONOMIST (July 13, 2006), https://www.economist.com/europe/2006/07/13/the-perils-of-project-mania; David Litterick, *Chirac Backs Eurocentric Search Engine*, TELEGRAPH (Aug. 31, 2005), https://www.telegraph.co.uk/finance/2921407/Chirac-backs-eurocentric-search-engine.html.

161. *See* European Commission Press Release IP/08/1747, Now Online: "Europeana," Europe's Digital Library (Nov. 20, 2008), https://ec.europa.eu/commission/presscorner/detail/en/IP_08_1747.

162. Alexandre Moatti, *Bibliothèque Numérique Européenne: De l'Utopie Aux Réalités*, *in* RÉALITÉS INDUSTRIELLES: ANNALES DES MINES 43–46 (Eska ed., 2012).

163. *See* David Meyer, *Europe is Starting to Declare its Cloud Independence*, FORTUNE (Oct. 20, 2019), https://fortune.com/2019/10/30/europe-cloud-independence-gaia-x-germany-france/.

164. Shira Ovide, *Microsoft's Bing Isn't a Joke Anymore*, BLOOMBERG OPINION (July 19, 2016), https://www.bloomberg.com/opinion/articles/2016-07-19/microsoft-turns-bing-from-a-joke-into-an-ad-business.

users for searches started on Bing.[165] Today, Bing remains a distant number-two competitor to Google Search in most markets.[166]

This challenge is compounded in multi-sided markets where the monopolist offers high-quality, zero-price services to one side of the market.[167] In such markets, adding a homogenous product by itself might not be sufficient to create significant competitive pressure. More importantly, the remedy design costs incurred by the antitrust decision maker will be higher. An effective remedy in multi-sided markets requires more than setting price levels or trade terms. In multi-sided markets, it is the relative *structure* of prices on various sides, rather than the price *level* on one side, that determines firm outputs. This complexity is likely to create high remedial costs. More generally, if the antitrust decision maker wants to subsidize a competitor that can rely on market forces to stay in business, it will need to identify a "money side" that makes subsidies to users sustainable. One way to solve this problem in the short term is for the antitrust decision maker to use the antitrust fine as the "money side" of the new firm and to cross-subsidize zero-price activities on the other side. But this leaves open the identification of a viable business model which is able to finance zero-price services in the long term. That said, when overcoming the monopolist's advantages does not require large, continual investment to enable operation at a large scale (e.g., when such advantages result from user loyalty or stickiness), a subsidy might help jumpstart competition. Such a subsidy might be especially justified if the market cannot be relied upon to finance such competitors inter alia due to perceived high risks.

This leads to the second goal. A subsidy might be granted to introduce product or service differentiation (hereinafter, product differentiation) in a digital market subject to monopoly.[168] Consider the following example. Before the remedy, firm A supplies a social network and sets users' privacy terms at a level reflecting exploitative (quality-adjusted) prices. To finance its free offering of social network functionality to users, A sells targeted ad space to

165. *See* Hylton, *supra* note 29, at 12.

166. *See Search Engine Market Share Worldwide*, STATCOUNTER: GLOBALSTATS, https://gs.statcounter.com/search-engine-market-share (attributing a 92.07% market share to Google Search and a 2.44% market share to Bing from February 2019 to February 2020 worldwide, which holds true in regional markets like the United States and Europe).

167. *See, e.g.*, STIGLER REPORT, *supra* note 2, at 30, 91; Michal Gal & Daniel L. Rubinfeld, *The Hidden Cost of Free Goods: Implications for Antitrust Enforcement*, 80 ANTITRUST L.J. 521, 521–22 (2016).

168. Professor Diane Coyle has called for building "public service digital corporations that offer better services to consumers" in digital markets, along the lines of the BBC. *See* Diane Coyle, *We Need a Publicly Funded Rival to Facebook and Google*, FIN. TIMES https://www.ft.com/content/d56744a0-835c-11e8-9199-c2a4754b5a0e (last visited Mar. 16, 2020).

advertisers. A excludes rivals B, C, and D through exclusionary anticompetitive conduct. Monopolization is established, but given the high barriers to entry, A remains able to exercise significant market power even following a finding of antitrust liability. The antitrust decision maker enters into an agreement with firm B in which B agrees to offer services at higher privacy levels, provided that it be compensated for lost revenue from converting from its current business model plus an additional (small) profit.

The remedy seeks to promote competition through indirect entry with imperfect substitutes which are under-supplied in the market. Such competition is especially important in markets where fixed costs are high relative to the market size and the market undersupplies variety.[169] Substantial scale and scope economies or network effects compound this problem. Anecdotal evidence of limited product variety offered by a monopolistic firm exists in relation to privacy. Facebook's dominance in the market for personal social networks leaves some demand for privacy unserved. When competition is *for* the market, the monopoly structure totally eliminates product differentiation not supplied by the incumbent. Furthermore, product differentiation offered by a multi-product monopolist is often an imperfect substitute for a market in which product variety is determined by interfirm rivalry.[170] Certainly, users can choose between Google Waze and Google Maps, or between Facebook Messenger and WhatsApp. But if such diversification is driven by economies of scale and scope, then the degree of differentiation offered by a monopolist will presumably be lower than under competition because the monopolist will have incentives to integrate products to a relatively greater extent than competing firms. Put differently, a multi-product monopolist will produce less differentiation than monopolistic competition.[171]

Product differentiation might be especially useful in markets in which the selected monopolistic product or service might not be the "best" one. This was so, for example, in the competition between VHS and Betamax for the VCR market, where the former won out despite the latter probably being

169. *See* JOEL WALDFOGEL, THE TYRANNY OF THE MARKET: WHY YOU CAN'T ALWAYS GET WHAT YOU WANT 25 (2009).

170. *See* Shabtai Donnenfeld & Lawrence J. White, *Product Variety and the Inefficiency of Monopoly*, 55 ECONOMICA 393 (1988); David Besanko, Shabatai Donnenfeld & Lawrence J. White, *Monopoly and Quality Distortion: Effects and Remedies*, 102 Q.J. ECON. 743 (1987).

171. This is all the more so where there are economies of scale. *See* Kelvin Lancaster, *The Economics of Product Variety: A Survey*, 9 MKTG. SCI. 189 (1990). This result will generally hold true when fixed costs (like R&D) are constant and do not rise with market size (for example, when restrictions to trade are lifted). *See* JOHN SUTTON, SUNK COSTS AND MARKET STRUCTURE (1991); *see also* Avner Shaked & John Sutton, *Relaxing Price Competition Through Product Differentiation*, 49 REV. ECON. STUD. 3 (1982).

technically superior.[172] When this is the case, subsidies to a "second-place system" might act as a welfare-enhancing counteractive policy.[173] Product differentiation can also offset some of the lock-in effects that result from network and scale economies.

Last, a subsidy might be even more apt when the market undersupplies a good which creates significant positive externalities like privacy, accurate and credible information, or opinion diversity. Of course, the function of antitrust law is not to maximize, let alone promote, positive externalities. But the failure of the monopoly market to supply positive externalities constitutes an antitrust issue when this correlates with a loss in consumer welfare attributable to anticompetitive conduct. In digital markets, users of a monopoly service based on targeted ads might, for example, be better off when the antitrust remedy enables the entry of a subscription-based business model.

B. CONDITIONS FOR SUBSIDIZATION OF A COMPETITOR AS AN ANTITRUST REMEDY

Any subsidy award involves the exercise of discretion, and the cost of getting it wrong is a net waste of taxpayers' dollars. Accordingly, subsidization of a firm should only be used in limited cases in which (i) market self-correction cannot be expected in the short term, (ii) there are clear and significant benefits to its implementation, and (iii) no other less-interventionist remedy can achieve equivalent results.

Beyond these high-level conditions, practicalities also matter. The choice of which firm to subsidize might not be straightforward. In cases where competition has taken place for the market, there are no actual rivals. Yet the subsidized firm need not necessarily be one that was specifically excluded (in the above example, B or C) as market conditions might have changed significantly since exclusion. The difficulty then lies in choosing which firm to subsidize. The main decisional criterion should be the expected success of the selected firm in restoring competition by way of viable commoditization or diversification of the market. As a rule, the subsidized firm should possess the organizational capabilities and resources needed to meet all or most of the demand for commoditized or differentiated services that it will take away from the monopolist. The decision maker can auction the role in order to solicit proposals, but difficulties might arise in assessing a firm's actual chances of

172. As noted earlier, Brian Arthur used this example to show how random and trivial circumstances can lock a market into a suboptimal technological equilibrium. *See* Arthur, *supra* note 51, at 92–93.

173. David, *supra* note 61, at 231. The subsidy ought to be exclusive so that rivals make an effort to avoid being left in third place.

success. Accordingly, this remedy will be easier to apply in markets where fringe competitors have had some success in competing, though weakened by exclusionary conduct. By the same token, established industry players or startups located in adjacent markets might have a comparative advantage over firms from other industries. Naturally, another condition is that the product's life cycle should be longer than the time needed for a subsidized firm to expand its capacity.

A variation of our suggestion consists in indirectly subsidizing competitors by awarding vouchers to consumers harmed by the antitrust violation. The vouchers can be redeemed when consumers contract with competitors of the incumbent.[174] Vouchers have an expiry date in order to strengthen incentives for fast entry or expansion in the market. One of the main advantages of this alternative is to leave to the market the choice of which rival must be subsidized. This appears advantageous compared to agencies and courts directly tampering with the market structure and selecting one product over the other. That said, vouchers will only work if rivals are assured that a sufficient number of consumers will use them to buy their services. While this might work in digital markets subject to subscription or transaction-based business models, there is more uncertainty about the efficacy of vouchers in multi-sided markets with free goods/services. In such circumstances, a voucher to use an alternative platform will not be sufficient to restore competition unless it grants money back. There will also be substantial enforcement costs incurred by the government to track users, collect vouchers, and monitor their effective and non-fraudulent use.

The compensation to be offered depends on market conditions and the position of the subsidized firm in the subsidy and post-subsidy periods. The higher the barriers to expansion or diversification, the higher the necessary subsidy. Yet since the goal is to subsidize viable commoditization or diversification that is undersupplied in a monopoly market, the antitrust decision maker may lack a benchmark for determining the costs of expansion or of producing a differentiated good so as to reach a critical mass of users. As with the question discussed above of which firm to subsidize, one conventional way to resolve this conundrum is to auction the subsidy rights, as "firms reveal information about industry cost when competing with each other."[175] Instead of setting a price a priori, the antitrust decision maker would award the subsidy to the bidder who best meets certain conditions. For example, the subsidy may be awarded to the bidder who offers to supply a

174. We are grateful to Giacomo Calzolari who suggested this idea to us.

175. Tirole, *supra* note 159, at 1671.

good at the lowest per-unit price.[176] This option has two advantages. It reduces the risk of ill-informed choices by decision makers, and it limits incentives to capture. Observe that compensation need not equal the full costs of expansion since the added capacity or diversification may allow the subsidized firm to enjoy scale, scope, or learning economies both during the subsidization period and afterwards.

The success of the subsidized firm might be contingent on other remedies. Most importantly, data portability and interoperability requirements can play an important role in dissipating data-related barriers to entry as they reduce switching costs and facilitate multi-homing. Data sharing[177] and algorithm sharing[178] remedies might thus increase a subsidized firm's potential for successful commoditization or differentiation. Where this is the case, the decision maker should consider adding such remedies, though keeping a close eye on the increased costs of remedial design and implementation.

Finally, incumbent monopolists should be given an opportunity to take voluntary steps to restore competition and limit antitrust intervention before the award of the subsidy. The monopolist would be motivated to do so because once the subsidized firm expands in the market, the monopolist might have unused capacity. Even in the case of differentiated products, if scale economies are significant, a reduction in the demand served by the monopolist would lead to increased unit costs and reduced profitability. Accordingly, the threat of subsidized entry may by itself stimulate the infringer to take steps to avoid the application of the remedy. An antitrust decision maker might thus publish its findings on how the anticompetitive conduct has affected market conditions and allow sufficient time for antitrust infringers to restore lost competition, for example by offering a divestiture.

C. PROBLEMS RAISED BY SUBSIDIZATION OF A COMPETITOR

Several problems affect subsidies as an antitrust remedy. First, antitrust's institutional framework is not designed to make the kind of discretionary choices involved in the award of subsidies. Antitrust agencies and courts protect the competitive process by enforcing limited rules that proscribe "bad" business conduct by firms with monopoly power. Antitrust agencies and courts only reluctantly make proactive choices that confer advantages on competing firms, as per the maxim "antitrust protects competition, not

176. *See* Oliver E. Williamson, *Franchise Bidding for Natural Monopolies—In General and with Respect to CATV*, 7 BELL J. ECON. 73 (1976).

177. *See, e.g.*, GRAEF, *supra* note 13. For the effects of data sharing on innovation, see Cockburn, Henderson & Stern, *supra* note 100, at 125–28, 139–43.

178. *See infra* Part III.

competitors." Entrusting antitrust agencies and courts with the allocation of subsidies might thus be an unwarranted stretch. At the same time, antitrust agencies and courts possess expertise in assessing price and non-price competition, comparing the welfare properties of distinct business models, and analyzing the effects of changes in market structure on consumer welfare. Additional expertise might also be sought by appointing a technical committee, as in the *Microsoft* case. Furthermore, antitrust agencies enjoy a comparative advantage over other government institutions that must bid for appropriations to the legislative and/or the executive branch.[179]

Second, the subsidy remedy is unlikely to produce instant effects on marketplace competition. Building a firm takes time. This is one more reason why, as a rule, subsidies should be awarded to actual competitors, not potential ones.

Third, the remedy might harm dynamic efficiency. There are two problems here. The first is conventional and can be easily disposed of. By reducing the *ex post* ability of a monopolist to enjoy supra-competitive profits, the remedy harms the monopolist's and other firms' *ex ante* incentives to innovate. Recall, however, that our hypothesis is one in which monopoly power results from anticompetitive conduct. In such cases, antitrust remedies that intend to restore competition that was unlawfully deterred do not harm dynamic efficiency. Provided the antitrust decision maker makes appropriate choices, the monopoly profits that are eroded are unlawful payoffs. Furthermore, the antitrust decision incentivizes other firms to innovate by signaling a reduced risk of anticompetitive entry deterrence.

The second potential harm to dynamic efficiency is more serious. The remedy might overreach by going beyond restoring lost competition. Consider, for example, a subsidy of such magnitude that it allows a less efficient beneficiary to engage in a long-term aggressive pricing strategy that leads to the exit of the more efficient incumbent. In such a case, the remedy chills ex ante incentives to invest. Firms in digital markets might assume they will not be able to extract profits from lawfully acquired monopoly positions.[180] As a result, poorly calibrated subsidies will lead to a decrease in the number of firms that enter digital markets. Moreover, firms might have an incentive to lose the ex ante rivalry game in order to secure the ex post award of public resources in the long-run subsidy game.

179. *Id.*

180. For the importance of legally gained profits as a stimulant for competition and innovation, see Verizon Commc'ns Inc. v. L. Off.s of Curtis V. Trinko, LLP, 540 U.S. 398 (2004).

V. TEMPORARY ANTITRUST SHUTDOWNS

The third radical remedy consists of ordering the temporary shutdown of an antitrust infringer's digital service. To illustrate, suppose that a digital firm is required to shut down user interfaces such as web pages or applications. Such a shutdown might block, for example, users' access to Google Search or Facebook's social network. A shutdown aims at restoring opportunities for competitors to build an installed base by forcing users to (temporarily) migrate to alternative services. This might help restore competition to what it would have been were it not blocked by unlawful means. Shutdowns can potentially stimulate competition in two ways. First, they can expose users to competing services. This is mostly relevant in digital markets where users single-home rather than multi-home due to sunk costs, lock-ins arising from network effects, and behavioral limitations.[181] Second, shutdowns might enable competitors to grow more quickly and reach scale and scope economies or network effects which might be necessary for them to compete effectively.

This Part first briefly reviews the experience of shutdowns in the law in general and in antitrust law in particular (A). Once this is done, some limiting conditions for the application of antitrust shutdowns in digital market can be specified (B). The potential effects of shutdowns on competition are then discussed (C).

A. SHUTDOWNS IN THE LAW

In other areas of the law, shutdowns are a common practice. Leaving aside the controversial case of internet blockades for purposes of political censorship,[182] government agencies and courts have used shutdowns for anti-piracy or anti-counterfeiting purposes in intellectual property cases.[183] For example, in January 2012, the U.S. Department of Justice shut down the websites of peer-to-peer service Megaupload on grounds of copyright law infringement. Shutdowns are also sometimes used in the context of law

181. Lior Frank, *Boundedly Rational Users and the Fable of Break-Ups: Why Breaking-Up Big Tech Companies Probably Will Not Promote Competition from Behavioral Economics Perspective*, 46 WORLD COMPETITION 373 (2020). Shutdowns might create positive externalities in the way of a "digital detox," limiting some harmful user addictions.

182. *See* Philip N. Howard, Sheetal D. Agarwal & Muzammil M. Hussain, *When Do States Disconnect Their Digital Networks? Regime Responses to the Political Uses of Social Media*, 14 COMM. REV. 216 (2011) (discussing China's actions blocking access to Twitter and other social networking sites as a means to control conflict and dissent in the Xingjang region). Similarly, Haiti and Thailand have shut down YouTube for political reasons. *See Exploring the Extent of Internet Censorship in* Thailand, CTN NEWS (2020), https://www.chiangraitimes.com/tech/exploring-the-extent-of-internet-censorship-in-thailand/.

183. Annemarie Bridy, *Internet Payment Blockades*, 67 FLA. L. REV. 1523 (2015).

enforcement or intelligence activities.[184] In April 2013, the press reported that the police had shut down cellular services after the Boston Marathon bombing out of fear that additional explosive devices might have been rigged to detonate using a remote trigger.[185] In rare cases, shutdowns have been used to remedy market failures like moral hazards in the financial industry.[186] Recently, an executive order by the President banned transactions relating to mobile applications TikTok and WeChat—the equivalent of a shutdown—amidst concerns of threats to national security, foreign policy, and industrial espionage from the Chinese Communist Party.[187] The executive order did not enter into force.[188] But it became a bargaining chip when the Trump administration tried to force the sale of TikTok's U.S. assets to domestic tech firms.

At first blush, the idea of shutdowns might strike the observer as counterintuitive to antitrust policy. Antitrust keeps market power in check by promoting rivalry.[189] Agencies and courts might thus be reluctant to remove a firm from a market—even a dominant one that has gained its power by anticompetitive means—to the extent that this entails a reduction in the competitive pressure exerted by marketplace rivalry. On further thought, however, such a reduction in rivalry in the short run might further antitrust goals if it provides an efficient tool for restoring competition in the long run.

Moreover, an affirmative case might be made that antitrust doctrine embodies an indirect remedial power to order shutdowns.[190] Little known today is the fact that revoking a firm's right to do business in a market was

184. *See* Jennifer Spencer, *No Service: Free Speech, the Communications Act, and Bart's Cell Phone Network Shutdown*, 27 BERKELEY TECH. L.J. 767 (2016) (discussing the shutdown of cell service at several BART stations to interfere with political demonstrations against police).

185. Chris Ziegler, *Is it Legal to Shut Down Cellular Networks in an Emergency?*, VERGE (Apr. 15, 2013), https://www.theverge.com/2013/4/15/4228132/is-it-legal-to-shut-down-cellular-networks-in-an-emergency.

186. *See* Richard E. Brown, *Enron/Andersen: Crisis in U.S. Accounting and Lessons for Government*, 25 PUB. BUDGETING & FIN. 20 (2005); Emilie R. Feldman, *A Basic Quantification of the Competitive Implications of the Demise of Arthur Andersen*, 29 REV. OF INDUS. ORG. 193 (2006).

187. *See* Press Release, U.S. Dept. of Commerce, Commerce Department Prohibits WeChat and TikTok Transactions to Protect the National Security of the United States (Sept. 18, 2020), https://www.benton.org/headlines/commerce-department-prohibits-wechat-and-tiktok-transactions-protect-national-security.

188. *See* Catherine Shu, *Second Federal Judge Rules Against Trump Administration's TikTok Ban*, TECHCRUNCH (Dec. 7, 2020), https://techcrunch.com/2020/12/07/second-federal-judge-rules-against-trump-administrations-tiktok-ban/?_guc_consent_skip=1609928674.

189. *See* Louis Kaplow, *Antitrust, Law & Economics and the Courts*, 50 Law & Contemp. Probs. 181, 210 (1987).

190. When U.S. Senator John Sherman was asked about remedies in relation to his proposed Act, he mentioned an "ouster of the corporation." Stephen Fraidin, *Dissolution and Reconstitution: A Structural Remedy, and Alternatives*, 33 GEO. WASH. L. REV. 899, 902 (1965).

accepted policy under U.S. antitrust law in the early twentieth century.[191] In the formative era, both the U.S. Supreme Court and state courts considered shutdowns an effective remedy to restore competition.[192] Admittedly, use by the states of their common-law power to order "charter revocation" or "license forfeiture" to sanction unlawful exercise of a franchise fell into disgrace due in part to concerns regarding increased unemployment and industry concentration.[193]

In the EU, the EC holds no direct power to grant or revoke corporate privileges. But member states do and could thus assist the remediation of antitrust infringements. Besides, the corporate law route need not be the sole legal instrument available for shutdowns. In some member states, a specific antitrust law basis exists for ordering shutdowns. In Italy, the competition agency can order a firm that does not comply with a remedial order to suspend its business activities for 30 days.[194] Admittedly, this provision—which has never been applied—is not a restorative remedy. But its existence suggests that antitrust might not have principled objections to shutting down businesses in other procedural contexts.

This background suggests that shutdowns do not raise hard doctrinal questions, but rather normative ones. In particular, should antitrust decision makers make more intensive use of shutdowns to restore competition in digital markets, and what limiting principles ought to be applied?

B. CONDITIONS FOR TEMPORARY ANTITRUST SHUTDOWNS

On their face, shutdowns are at odds with antitrust policy's pursuit of short or medium-term consumer welfare. In effect, an antitrust shutdown denies users access to a lawful service through the firm's market position might have been unlawfully obtained. Any antitrust shutdown in digital markets should

191. *Id*; *see also* James May, *Antitrust Practice and Procedure in the Formative Era: The Constitutional and Conceptual Reach of State Antitrust Law*, *1880–1918*, 135 U. PENN. L. REV. 495, 510 (1987) ("Late nineteenth century case law gave the states considerable authority to cancel corporate charters or revoke intrastate business privileges in response to ultra vires corporate misconduct and provided a particularly powerful basis for attacking corporate concentration, collusion, and predation.").

192. The U.S. Supreme Court held lawful a revocation of intrastate business privileges in response to a violation of Texas antitrust statutes. In addition, the threat of revocation has been used by states as a "condition" to obtain adherence to general substantive antitrust standards. May, *supra* note 191, at 512–14.

193. *Id.* at 501–02, 512–14.

194. Italian Competition and Fair Trading Act 1990, legge 10 ottobre 1990, n.287, Section 15 § 2 ("In the case of non-compliance . . . a time limit [should be set] for the payment of the fine. In cases of repeated non-compliance, the Authority may decide to order the undertaking to suspend activities for up to 30 days.")

thus be carefully calibrated with attention to consumers' interests. The task is then to think of limiting principles that avoid consumer harms.

A first limiting principle consists in restricting shutdowns to cases where actual competitors can offer alternative services to consumers. Otherwise, the short-term consumer harm is a pure deadweight loss.[195] There is demand for a service but no supply. The logic here is not distinct from that applied to fix-it-first remedies in merger cases. Fix-it-first remedies allow consumers to enjoy the pro-competitive efficiencies of mergers by requiring merging parties to identify a credible buyer for proposed divestitures and sometimes even to sell divested assets prior to obtaining agency approval.[196] Moreover, when transaction costs limit substitution possibilities, antitrust shutdowns should be supplemented by measures that facilitate consumer migration (for example, data portability or interoperability requirements). Note that the alternative service need not be identical to the service that was shut down. Yet its quality and trade terms should not be so different as to create significant consumer harm in the short to medium run. By announcing the temporary shutdown ahead of time, courts or agencies can give competitors time to prepare to provide such services, even if they did not exist before or were quite limited due to the anticompetitive conduct.

Second, the shutdown need not apply to all users of the incumbent firm. If its aim is to expose users to other services, it might be unnecessary to shut down services to users who are aware of competing services or who are already multi-homing should such a segmentation between users be possible.

A third limiting principle involves temporal considerations. The shutdown should last no longer than is necessary to expose competing services to users and to allow such services to overcome entry barriers resulting from anticompetitive conduct. In this respect, short shutdowns will be more effective at allowing competitors to scale up their business in digital markets where costs are mostly fixed compared with markets in which firms incur significant variable costs or markets in which economies of scale and scope in data analysis are easier to reach. Interestingly, in some situations, the two potential goals of shutdowns might need to be balanced. While a short shutdown might be sufficient to introduce users to competing services, if the shutdown does not help competitors gain a sufficient number of users to reach scale and scope economies or network effects that are comparable to those of the incumbent monopolist, then users might perceive competing services to

195. This consideration is strengthened when the platform enables exercise of freedom of speech.

196. *See* R. Hewitt Pate, *Antitrust Enforcement at the United States Department of Justice: Issues in Merger Investigations and Litigation*, 2003 COLUM. BUS. L. REV. 411, 422–24 (2003).

be inferior. Indeed, some users might try a competing service only once before it succeeds in reaching such economies or network effects and form a negative opinion of its capabilities, thereby possibly limiting competition in the long run. This problem can be partly overcome by explaining to users the rationale of the remedy and inviting them to aid in its application by retrying the competing service at a subsequent stage.

A fourth limiting principle involves the need to reduce any potentially chilling effects on lawful investment by incumbents, a concern already encountered when mandatory sharing of algorithms was discussed. Antitrust agencies and courts should take incentive effects into account when determining whether to order a shutdown and for how long. This is especially important where the incumbent's comparative advantages were only partly derived from its anticompetitive exclusionary conduct.

Fifth, shutdown remedies are likely to impose significant short-term disruption on users. Users subject to an interruption of service might not switch to rival firms, perhaps due to unawareness of the purpose of the shutdown or the existence of competitive alternatives. To put the point clearly, faced with a Google Search shutdown, search users might conclude that the internet is out of service. This can be relatively easily fixed by mandating that attempts to use the shut-down service automatically trigger an explanatory message. More importantly, users might incur high switching costs for at least three reasons. First, users might lose any payments made for subscription to the service. This is relatively easy to remedy by requiring the infringer to return such payments to users. Second, consumers may lose sunk costs in duplicating the technological interconnections established with the incumbent. Consider, for example, sellers operating on a multi-sided network operated by a monopolist. Suppliers might suffer disruption and significant harm when their technological infrastructure relies on bottleneck services. This may include advertisers in the case of Google or Facebook, merchants in the case of Amazon, or content providers in the case of Netflix. Moreover, users might rely on a variety of related services, such as business intelligence and data analytics, cloud computing, productivity tools, application programming interfaces (APIs), and software platforms provided by the incumbent firm and integrated into their own operations. In such cases, the shutdown of the monopoly service might create significant costs. Finally, if the comparative advantages of the incumbent partly translate into consumer benefits, users will not be able to benefit from such advantages during the shutdown, at least not in the short run. Consider, for example, a shutdown of Google Search. If Google's algorithm is much better than its rivals', users will not be able to search as effectively, at least until Google's rivals reach scale and scope

economies in data analysis. These issues require careful crafting of the remedy, including additional remedies that ensure interoperability between non-core services and rival firms. The extent of short-run harms should be balanced with long-term benefits. Where harms are significant and cannot be overcome cost effectively, shutdowns should not be ordered.

Finally, shutdowns also inflict costs on employees, contractors, suppliers, and business customers. These costs can be partially mitigated by ordering temporary shutdowns, not permanent ones. In addition, the costs of antitrust shutdowns might be further contained by limiting their scope to specific user interfaces (e.g., applications), platforms (e.g., mobile phones), geographies (e.g., regional), or lines of business (e.g., verticals).

To sum, shutdowns may involve high costs. However, as argued in this Section, under some specific conditions they may increase consumer welfare.

C. EFFECTS OF TEMPORARY ANTITRUST SHUTDOWNS

What are the effects of temporary shutdowns on market competition? To date, no empirical economic studies have looked at this question. However, Google's exit from the Chinese search market in 2010 might allow us to draw crude anecdotal inferences about the market share effects of antitrust shutdowns. The key facts for purposes of this discussion are the following. Google entered China's search market in 2006 with the launch of a local website.[197] It held a post-entry share of 27%, making it second to incumbent firm Baidu.[198] In January 2010, Google announced a reassessment of its search presence in China in response to increased censorship from the Chinese government.[199] At the end of March 2010, Google decided to redirect users of

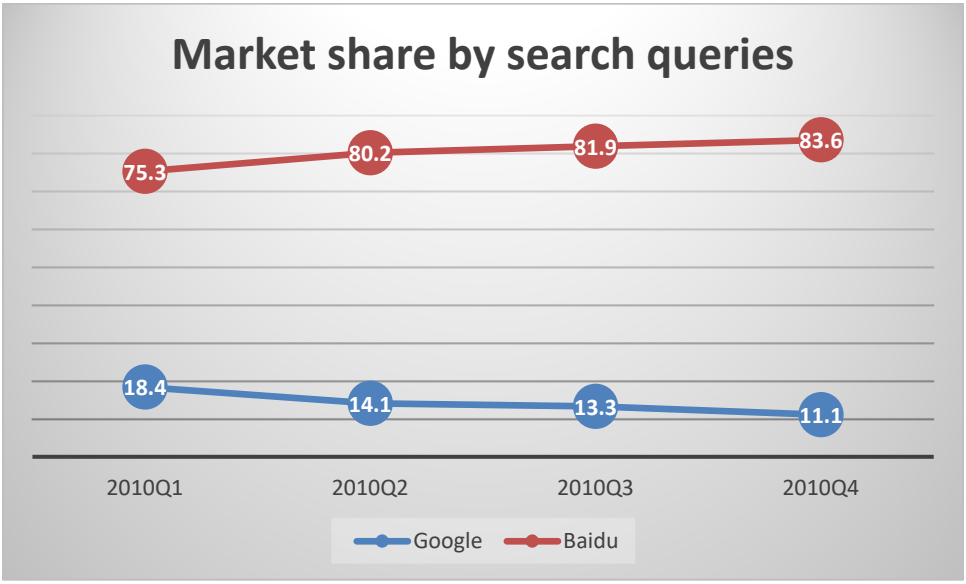
197. Google also entered the market with related infrastructure. Previously, Google provided search functionality to China by "hosting servers outside Chinese territory . . . [and essentially] from California." *See* Jyh-An Lee, Ching-Yi Liu & Weiping Li, *Searching for Internet Freedom in China: A Case Study on Google's China Experience*, 31 CARDOZO ARTS & ENT. L.J. 405, 425 (2012).

198. *See* Clive Thompson, *Google's China Problem (and China's Google Problem)*, N.Y. TIMES (Apr. 23, 2006), https://www.nytimes.com/2006/04/23/magazine/googles-china-problem-and-chinas-google-problem.html. Four years later, the press reported that Google had a 33% share of the search market behind Baidu's 63% share (measured in revenue). *See* David Barboza, *Baidu's Gain from Departure Could Be China's Loss*, N.Y. TIMES (Jan. 13, 2010), https://www.nytimes.com/2010/01/14/technology/companies/14baidu.html.

199. In the four preceding years, Google had entertained complicated relations with the Chinese government, which had repeatedly requested increased self-censorship and blocked YouTube in 2009. This culminated with a series of hacks on the Gmail service. *See* Frank Watson, *Forget Altruism: China Too Big a Prize for Google to Give Up*, SEARCH ENGINE WATCH (Jan. 5, 2011), https://www.searchenginewatch.com/2011/01/05/forget-altruism-china-too-big-a-prize-for-google-to-give-up/.

its Chinese site to its unfiltered Hong Kong website.[200] What were the effects of Google's exit on the market structure of search services in China? Since we are interested in temporary shutdowns, we focus here on the short term. Google steadily lost market share, while Baidu's market share steadily increased (see Figure 2 below).[201] Other anecdotal sources confirm this conclusion.[202]

Figure 2: Market Shares of Google and Baidu in the Chinese Market in 2010 (Source: iResearch for China Internet Watch)



In 2011, Google was no longer the number-two search engine in traffic terms, having been replaced by the Chinese firm Soso (a subsidiary of tech giant Tencent). Google was closely followed by another Chinese firm, Sogou

200. *See* David Drummond, *A New Approach to China*, GOOGLE PUB. POL'Y BLOG (Jan. 12, 2010), https://publicpolicy.googleblog.com/2010/01/new-approach-to-china.html (explaining why Google was redirecting traffic). The shuttering of Google Search's China operations (Google.cn) did not mean a complete exit. Google retained its application for an internet Content Provider (ICP) license in order to pursue R&D (Android phone development) in China, and it also continued to provide non-search-related commercial services such as music, translation, and mapping. Google's ICP license was renewed in July 2010 by the Chinese government. Lee, Liu & Li, *supra* note 197, at 418.

201. *See* Incitez China, *Baidu More Dominant with 83.6% Search Query Market Share,* CHINA INTERNET WATCH (Feb. 24, 2011), https://www.chinainternetwatch.com/968/search-market-share-q4-2010/.

202. *See, e.g.*, *Google Loses Market Share to Baidu*, SHANGHAI DAILY (July 20, 2010), http://www.china.org.cn/business/2010-07/20/content_20535620.htm.

(a subsidiary of Sohu).[203] By October 2012, Google was the number-four market player by share of total search engine traffic and number of visits (see Figure 3) if one takes traffic from its Hong Kong site into account.[204]

Figure 3: Market Share of Search Engines in China, October 2012 (Source: Hitwise)

The above data are at best flimsy. That said, Google's exit from China is an adequate proxy for an evaluation of the effectiveness of antitrust shutdowns because it is a conservative story. Google's China exit underestimates the market share effects of shutdowns in at least two relevant dimensions. First, Google's China exit was not a strict shutdown. Search users located in China have remained free to use its Hong Kong site, though subject to filtering by governmental restrictions known as "the Great Firewall," which often lead to a slow response and system breakdowns.[205] Second, Google exited from a

203. *Daniel Cai*, *CNNIC Published China Search Engine Market Research Report 2011*, THE EGG, https://www.theegg.com/seo/china/cnnic-search-engine-market-report-2011/ (last visited July 28, 2020).

204. *Market Share of Search Engines in China in October 2012, by Visits*, STATISTA (Nov. 19, 2012), https://www.statista.com/statistics/277486/market-share-of-search-engines-in-china-by-visits/.

205. David Drummond, *A New Approach to China: An Update*, GOOGLE BLOG (Mar. 22, 2010), https://googleblog.blogspot.com/2010/03/new-approach-to-china-update.html; Min Jiang, *The Business and Politics of Search Engines: A Comparative Study of Baidu and Google's Search Results of Internet Events in China*, 16 NEW MEDIA & SOC'Y 212, 212–16 (2014). The Great Firewall involves internet protocol blocking, keyword blocking, and packet filtering.

market dominated by Baidu. Google's residual user base in China might thus have been an inelastic preference minority unlikely to ever switch to Baidu.[206]

The above data lend support to the idea that shutdowns can be an effective industrial policy instrument.[207] A decade later, Google remains irrelevant in China in spite of consumer polls showing that Chinese users overwhelmingly prefer Google Search to Baidu.[208] The legal scholar Cynthia Liu has discussed how the systematic blocking of YouTube, Facebook, Twitter, and Flickr in China allowed the development of a series of successful Chinese clones shielded from foreign competition.[209] But what is more important for the purposes of this Article is that the Google natural experiment suggests that shutdowns appear successful at shifting market share.

Against this backdrop, Google's China exit is uninformative on whether shutdowns can restore competition *for* the market. In our case study, the shutdown targeted the number-two firm in a market that had already tipped. A minimum condition for an antitrust shutdown to restore competition *for* the market is that the targeted firm must have achieved a critical mass of users. In our case study, only a shutdown of Baidu might have had some potential to reestablish competition for the market. For indeed, it is a safe assumption that shutting down a dominant firm would produce higher market share effects than shutting down a fringe competitor.

Similarly, the Google China exit case study provides no hints as to whether shutdowns might be used to promote competition *in* the market. In the short run, shutdowns reduce competition in the market. By removing one firm from the market, shutdowns might therefore be expected to limit the immediate range of options offered to users. But in the long run, temporary shutdowns

206. Note that the data for Google.cn in the graphs incorporates fringe services, such as maps or Gmail, kept active for a while by Google.cn.

207. *See* Felix Richter, *China's Parallel Online Universe*, STATISTA (Oct. 2, 2019), https://www.statista.com/chart/10706/online-services-in-china/.

208. In a 2018 survey on Weibo of over 17,500 search users in China, 72.8% of respondents replied "Google" when asked "If Google returns to China, which will you choose between Google and Baidu?" *See* Lai Lin Thomala, *Google Versus Baidu Preference in China as of August 2018*, STATISTA (Sept. 23, 2019), https://www.statista.com/statistics/995953/china-google-vs-baidu-preference/.

209. *See* Cynthia Liu, *Internet Censorship as a Trade Barrier: A Look at the WTO Consistency of the Great Firewall in the Wake of the China-Google Dispute*, 42 GEO. J. INT'L L. 1199, 1206 (2011) ("[T]he permanent blocking of YouTube in March 2009 saw homegrown competitors Youku and Tudou gain market share. The blocking of Facebook in July 2009 allowed Chinese copies like Ren Ren Wang and Kai Xin Wang to enjoy enormous success. Chinese internet giant Sina launched a nearly identical microblogging service less than two months after Twitter was cut off. After photo-sharing website Flickr was blocked, its Chinese clone Bababian grew steadily by using foreign technology without having to face foreign competition.").

might allow competing suppliers which have failed to make effective entry to reach critical mass, pending the re-entry of the dominant firm. For example, a temporary shutdown of Google Search might allow differentiated search engines that show fewer ads or extract less personal data, like DuckDuckGo or Qwant, to increase their market footprint.

VI. CONCLUSION

Digital markets create new challenges in restoring competition where competition was significantly harmed by anticompetitive conduct and where, as a result, the infringer enjoys significant incumbency advantages. To meet these challenges, this Article explored the adoption of three radical remedies. All three create significant potential to restore competition where conventional remedies would fail. At the same time, all three remedies risk harming consumer welfare if applied incorrectly. And all impose significant implementation costs on antitrust courts and agencies.

The three remedies are not equally realistic or radical. A mandatory duty to share algorithmic learning appears much more in line with existing practice and thus much closer to the outer boundary of antitrust than the subsidization of a competitor or an antitrust shutdown. In addition, not all remedies involve the same degree of agency or court discretion. For instance, in the case of a duty to share algorithmic learning and a shutdown, the point is to allow the market, not an agency or a court, to pick winners. If algorithmic learning is made available to all competitors who can benefit from it and existing competitors can potentially benefit from the violator's temporary shutdown, then the agency or court is reducing entry barriers to restore competition while not directly deciding which rival to favor. By contrast, government subsidization requires much higher trust in the ability of agencies and courts to allocate taxpayers' money optimally towards specific private interests and thus comes closes to pure industrial policy choices.

The proposed remedies are not necessarily interchangeable. Rather, each might be appropriate to address a different antitrust violation or to target different monopolists. For example, a duty to share algorithmic learning might be best targeted to address monopoly power issues where monopoly power is largely based on the quality of the algorithm used. And subsidization of a competitor might not work well if the market has huge winner-take-all tendencies (unless perhaps the subsidized firm is much better than the dominant incumbent). In some cases, a combination of remedies might work best. Furthermore, as noted above, it might also be useful to supplement the tools we suggest for facilitating competition by, for example, requiring compatibility and interoperability, prohibiting restrictions on multi-homing, or

reducing user switching costs. Such tools also limit the possibility of recurrence of unlawful conduct. Some of them, such as setting industry-wide standards that enable interoperability, might however need to be facilitated or encouraged by more interventionist regulatory tools that go beyond antitrust.[210]

Therefore, for all three, a careful assessment of their effects in specific circumstances must be carried out prior to any implementation of remedial roads less travelled. However, all three carry the potential of overcoming the insufficiencies of conventional remedial options. Furthermore, given that many markets for digital products or services are international, an effective restorative remedy in one jurisdiction can create positive spillovers in other jurisdictions.[211]

Finally, the three radical remedies discussed in this Article raise a common issue. In digital markets characterized by competition *for* the market, all three radical remedies will eventually lead to substitution of an incumbent monopoly by another monopoly. The implication is that radical remedies will not restore competition *in* the market beyond the short period of time during which firms compete for critical mass. The hard question is therefore this: if a monopoly outcome is to be expected, should antitrust agencies and courts promote the adoption of radical remedies in the first place? Yet there is value in restoring competition *for* the market. Even if re-tipping recurs and a new monopoly replaces an incumbent monopoly, competition for the market may enable a more efficient firm to serve the market. The threat of substitutability may also create contestability and reduce the exercise of market power by the incumbent. A series of sequential yet efficient monopolies may, in some circumstances, be preferred to an incumbent monopolist. Furthermore, the ability of antitrust courts and agencies to restore competition by recourse to radical remedies can be expected to limit the incentives of an incumbent monopoly from engaging in anticompetitive conduct in the first place.

210. *See, e.g.*, Gal & Rubinfeld, *Data Standardization*, *supra* note 83.

211. For an interesting example, see Page & Childers, *supra* note 146, at 354.