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MICROMANAGING TECHNOLOGY

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To what extent can the state control technological development? Companies are being suspected of overcomplicating products to extract more profit, not to add value for consumers, which I call complexity profiteering. For example, cars do not have to be connected to the internet, but connecting cars to the internet enables firms to remotely lock features so they can be sold for recurring fees. Bans of specific features that firms could profiteer from, which I call complexity prohibitions, are gaining public support as a solution to suspected predatory design practices. Is BMW trying to sell heated seats for monthly fees? The law can ban the practice. Is Apple putting serial numbers on iPhone batteries so that only Apple can replace them, thereby incentivizing consumers to buy a new phone when a new battery would suffice? The law can ban Apple from putting serial numbers on batteries, and require Apple to provide for free any tools needed to replace batteries.

I argue that complexity prohibitions can *reduce* state control over technology, thereby exacerbating the predatory design practices they aim to mitigate. In the short run, complexity prohibitions are easily circumvented because banning one complexity merely causes firms to exploit another. Mercedes-Benz responded to proposed bans on the sale of heated seats for monthly fees by selling faster acceleration for monthly fees. In the long run, as the law bans each new complexity that firms exploit and firms circumvent each ban by finding new exploitable complexities, this whack-a-mole would lead to design micromanagement, which would complicate product design and defeat the point of complexity prohibitions: to *eliminate* complexities that firms profiteer from. Replacing the iPhone 16's battery requires 20 tools, four of which Apple sells for $115, $190, $216, and $256.35, respectively.

As an alternative to complexity prohibitions, I propose a way to inform consumers so they can vote with their wallets against products suspected of complexity profiteering. I conclude by proposing a paradigm shift in tech law toward a pragmatic approach which accepts that indirect, market-based solutions may, in at least some instances, provide more control over technology than direct regulation would.

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INTRODUCTION

To what extent can the state control technological development and consumer product design? Direct regulation of specific technological features is gaining traction as a solution to apparently predatory design practices. In 2022, BMW started selling heated seats in its cars marketed in the United Kingdom for a monthly subscription fee.[1] The cars were sold with all the hardware needed for heated seats to work, but BMW put a remote software lock on that feature unless car owners paid the monthly fee.[2] In 2023, Polish train manufacturer Newag was revealed to have designed its Impuls trains to shut down if they are taken to repair shops not operated by Newag.[3] Even if the train had no defect, its software had GPS coordinates to third-party shops and instructions to disable itself "if it spends at least 10 days in one of these workshops."[4] The iPhone 16's parts are secured by adhesives and five types of screws, which require seven types of screwdrivers to remove.[5] Replacing the battery—necessitated by the fact that lithium-ion batteries "gradually lose [charge] capacity" over time[6]—requires 20 tools,[7] including four sold for $115, $190, $216, and $256.35 respectively on Apple's self-service repair shop.[8]

In these examples, product manufacturers may have used technology to overcomplicate the product so as to extract profit without adding value for the consumer—a phenomenon I call complexity profiteering. Cars and trains do not have to be connected to the internet to serve their intended purpose. But an internet connection allows firms to charge monthly fees for features

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[1] Peter Valdes-Dapena, *Why BMW Is Offering Heated Seats on a Monthly Subscription*, CNN (July 14, 2022), https://edition.cnn.com/2022/07/14/business/bmw-subscription/.

[2] *Id*. (heated seats are available on BMW's "online store and are activated remotely").

[3] Jakub Stępniewicz, Sergiusz Bazański & Michał Kowalczyk, *Dieselgate, but for Trains – Some Heavyweight Hardware Hacking*, BADCYBER (Dec. 5, 2023), *available at* https://badcyber.com/dieselgate-but-for-trains-some-heavyweight-hardware-hacking/.

[4] *Id*.

[5] *iPhone 16 Battery*, APPLE, https://support.apple.com/en-us/120642 (battery secured by adhesives); *iPhone 16 Screws*, APPLE, https://support.apple.com/en-us/120649 (top screw, crosshead screw, super screw, trilobe screw, and security screw).

[6] Geoffrey A. Fowler, *You're Charging Wrong: 5 Ways to Make Gadget Batteries Last Longer*, WASH. POST (Aug. 19, 2022), *available at* https://www.washingtonpost.com/technology/2022/08/19/battery-charging-tips/.

[7] Replacing the battery requires removing the back glass. The total number of tools required to remove both parts, excluding any overlaps, is 20. *See iPhone 16 Battery*, APPLE, *supra* note 5; *iPhone 16 Back Glass*, APPLE, https://support.apple.com/en-us/120638.

[8] *Self Service Repair*, APPLE, https://support.apple.com/self-service-repair (linking to official self-service repair shop). Selecting "iPhone," "iPhone 16," and "Battery" in the self-service repair website shows a battery press priced at $115.00, an adhesive de-bond fixture power supply priced at $190, a display press priced at $216.00, and a heated display removal fixture priced at $256.35. *See* SELF SERVICE REPAIR STORE FOR APPLE PRODUCTS, https://selfservicerepair.com/en-US/order.

that used to come for a one-time fee, like heated seats, and track vehicles real-time so that they can be shut down if they are taken to a third-party repair shop. Smartphone batteries do not have to be held with screws and adhesives, given the availability of smartphones whose batteries can be replaced with no tools because they are not held by screws or adhesives.[9] But affixing batteries with screws and adhesives raises the cost of replacing them, thus increasing the likelihood that a consumer purchases a new phone instead of a new battery.

An increasingly popular response to complexity profiteering is a class of laws and regulations that I call complexity prohibitions—bans on specific design features that firms could exploit for profit. Bills in California and New York, among others, would bar the sale of car features such as heated seats by subscription.[10] From February 18, 2027, smartphones sold in the European Union must have user-removable batteries.[11] California and New York have passed right-to-repair laws governing a wide range of consumer products,[12] which ban features that make "products difficult or impossible to disassemble" or restrict repairs to be "performed [only] by the manufacturers' authorized service networks," thus "creat[ing] barriers to independent repairs."[13] An even more widely applicable right-to-repair law took effect in the EU on July 30, 2024.[14] A remedy sought by the U.S. antitrust suit brought against Apple in March 2024 is to prohibit core features of products such as the iPhone and Apple Watch.[15] Complexity prohibitions like right-to-repair legislation and design restrictions have won support from economists and legal academics.[16]

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[9] *See How to Replace the Battery in the Galaxy XCover Pro*, SAMSUNG, https://www.samsung.com/uk/support/mobile-devices/how-to-replace-the-battery-in-the-galaxy-xcover-pro/ (battery replaceable with no tools); *Galaxy XCover6 Pro*, SAMSUNG, https://www.samsung.com/us/business/mobile/phones/galaxy-xcover-pro/ (IP68 "protect[s] from . . . complete submersion up to 5 feet for up to 30 minutes"). The iPhone 16, which secures its battery with screws and adhesives, has an IP 68 rating, which the Samsung Galaxy XCover 6 Pro also has. *iPhone 16 Specs*, APPLE, https://www.apple.com/iphone-16/specs/.

[10] *See* 2023 New York Senate Bill No. 8393 (April 12, 2024); 2023 California Assembly Bill No. 473 (Feb. 6, 2023); 2023 Illinois House Bill No. 2047 (Feb. 2, 2023).

[11] Council Regulation 2023/1542 of July 12, 2023, Concerning Batteries and Waste Batteries, Amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and Repealing Directive 2006/66/EC [*EU Battery Directive*], 2023 O.J. (L 191) 1, 37 arts. 11(1), 96(2)(a).

[12] N.Y. Gen. Bus. Law § 399-nn (McKinney) (Digital Fair Repair Act); 2023 Cal. Legis. Serv. Ch. 704 (S.B. 244); Cal. Pub. Res. Code § 42488 (West).

[13] FEDERAL TRADE COMMISSION, NIXING THE FIX: AN FTC REPORT TO CONGRESS ON REPAIR RESTRICTIONS 10 (May 7, 2021).

[14] Council of the EU Press Release 471/24, *Circular Economy: Council Gives Final Approval to Right-to-Repair Directive* (May 30, 2024) (enactment 20 days after publication).

[15] Complaint, *United States v. Apple*, No. 2:24-cv-04055 [*Apple Antitrust Complaint*], at ¶ 232 (D.N.J. Mar. 21, 2024), ECF No. 1.

[16] *See, e.g.*, AARON PERZANOWSKI, THE RIGHT TO REPAIR: RECLAIMING THE THINGS WE OWN (2022); Cesareo Contreras, *The USB-C Charging Port on the New iPhone 15 Is a Major*

I argue that microregulations of product design such as complexity prohibitions *reduce* state control over technology, thereby exacerbating the predatory design practices they aim to mitigate. In the short run, complexity prohibitions are easily circumvented because banning one complexity merely causes firms to exploit another. Mercedes-Benz responded to proposed bans on the sale of "any convenience or safety function . . . on [a] motor vehicle, including but not limited to heated seats"[17] by selling faster acceleration for a monthly fee in the U.S.[18] Even though EU law requires Apple to provide for free any tool needed to replace smartphone batteries,[19] Apple has already designed the iPhone so that battery replacement requires a toolkit measuring "20 inches wide and 47 inches high" and weighs 79 pounds,[20] which would deter repair while superficially complying with the requirement to provide all necessary tools for free. In the long run, as the law bans each new complexity that firms exploit and firms circumvent each ban by finding new exploitable complexities, this whack-a-mole would lead to micromanagement of product design, which would overcomplicate product design and defeat the point of complexity prohibitions: to *eliminate* design features that firms profiteer from.

Eminent advocates of complexity prohibitions seem to underestimate the sheer difficulty of micromanaging consumer product design. Professor Aaron Perzanowski argues that right-to-repair laws are enforceable because they "simply require [firms] to prioritize . . . familiar considerations" such as "durability and repairability."[21] While the dictionary definition of those words is indeed plain, a law cannot simply order firms to make a product repairable and durable because the subjectivity of those words would make compliance infeasible. There is no objectively discernible way to order Apple to make the iPhone "durable and repairable" because that would be tantamount to telling

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Win for Consumers, Expert Says, NORTHEASTERN GLOBAL NEWS (Sep. 14, 2023) (Prof. Elettra Bietti commenting on the EU common charger directive), *available at* https://news.northeastern.edu/2023/09/14/iphone-15-charger-eu-legislation/; Cesareo Contreras, *European Regulators Are Cracking Down on Alphabet, Apple and Meta. Will That Have an Impact on How Their Products Work Around the World?*, NORTHEASTERN GLOBAL NEWS (Mar. 28, 2024) (Prof. John Kwoka on the EU's common charger directive), *available at* https://news.northeastern.edu/2023/09/14/iphone-15-charger-eu-legislation/.

[17] N.Y. Gen. Bus. Law § 399-nn (McKinney) (Digital Fair Repair Act); 2023 Cal. Legis. Serv. Ch. 704 (S.B. 244); Cal. Pub. Res. Code § 42488 (West).

[18] *Mercedes-Benz USA Announces Performance Acceleration On-Demand Upgrade for EQE and EQS Customers*, MERCEDES-BENZ, https://media.mbusa.com/releases/release-1abd31f58af6a0ae7f6711444305a4c7-mercedes-benz-usa-announces-performance-acceleration-on-demand-upgrade-for-eqe-and-eqs-customers (faster 0 to 60 acceleration).

[19] *EU Battery Directive*, art. 11(1).

[20] SELF SERVICE REPAIR STORE, *Tool Kit Rental*, https://www.selfservicerepair.com/en-US/tool-kit-rental.

[21] Aaron Perzanowski, *Consumer Perceptions of the Right to Repair*, 96 IND. L.J. 361, 389 (2021).

Apple to take it easy on the screws and glue—or, put differently, telling firms not to get *too* greedy. The law can only ban specific design features or order firms to take specific actions, such as banning the use of adhesives on iPhone batteries and requiring repair tools to be provided for free, many of which the law has mandated and Apple has circumvented. As this the rest of this Article elaborates on, complexity prohibitions, despite their nascency, already appear to be failing to achieve their objectives or even undermining themselves.

The inefficacy of complexity prohibitions prompts a question: is there a cheaper and more effective solution to complexity profiteering? I propose a system to inform consumers about complexity profiteering so they can vote with their wallets against firms that engage in it. Consumers who are wary of complexity profiteering appear to have made firms desist without regulatory micromanagement of product design. BMW ended its subscription program for heated seats after about a year, citing negative market reactions.[22] In the first quarter of 2024, the share of iPhones among newly activated phones in the U.S. was 33 percent—the lowest since 2018[23]—and Apple has overhauled iPhone features in apparent response to market pressure.[24] Even if consumers currently buy from firms that engage in complexity profiteering,[25] the state need not decide how many types of screws should be in an iPhone in order to steer consumers toward repairable products. Smartphones and computers with removable batteries that perform on par with iPhones[26] and MacBooks[27] are already available to consumers, meaning that consumers who do not yet use these products could buy them if only they knew about them. Put differently, regulators must at least consider whether it would be more effective to inform

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[22] Alistair Charlton, *BMW Drops Controversial Heated Seats Subscription, To Refocus on Software Services*, FORBES (Sept. 7, 2023) (a BMW representative stating that "customer uptake" was "not high" because "[p]eople feel that they paid double"), *available at* https://www.forbes.com/sites/alistaircharlton/2023/09/07/bmw-drops-controversial-heated-seats-subscription-to-refocus-on-software-services/?sh=34aa2d026d1d.

[23] John Koetsier, *Apple iPhone Sales Hit 6-Year Low as Percentage of New Activations*, FORBES (April 24, 2024), https://www.forbes.com/sites/johnkoetsier/ 2024/04/25/apple-iphone-sales-hit-6-year-low-as-percentage-of-new-activations/.

[24] *See infra* Section III.A.

[25] *Cf.* Michael A. Carrier, *How the Federal Trade Commission Can Use Section 5 to Strengthen the Right to Repair*, 37 BERKELEY TECH. L.J. 1145, 1165-67 (2022) (citing the iPhone as an example of "restrictions that have . . . everything to do with preventing repair").

[26] *See* APPLE, *supra* note 9 (iPhone 16 has 6.1-inch display, 6-core CPU, 22-hour video playback, and IP68 water resistance rating for $799); *Galaxy XCover6 Pro Specs*, SAMSUNG, https://www.samsung.com/us/business/mobile/phones/galaxy-xcover-pro/ (6.6-inch display, 8-core CPU, 20-hour video playback, IP68 water resistance, and removable battery for $599).

[27] *Framework Laptop 13*, FRAMEWORK, https://frame.work/products/laptop13-intel-ultra-1/configuration/new (13.5-inch Intel version with 32GB memory and 1TB SSD storage selling for $2,099); *MacBook Pro*, APPLE, https://www.apple.com/macbook-pro/specs/ (14-inch M4 MacBook with 24GB memory and 1TB SSD storage selling for $1999).

consumers about complexity profiteering, to restore firms' natural incentive to be afraid of losing business to competitors, before trying to micromanage and outwit firms at designing their own products. If, as the EU apparently believes, it is worth creating a website to tell consumers about how to repair products,[28] it is worth telling consumers which products are designed to thwart repair so that they do not buy them in the first place. If consumers decide not to buy an iPhone after learning that its battery cannot feasibly be replaced, the state would not have to teach them how to replace old iPhone batteries.

This Article proceeds as follows. Part I establishes that complexity prohibitions would be ineffective in the short run and self-defeating in the long run. I use examples of products such as smartphones, cars, and charging cables, as well as enacted or proposed legislation in various U.S. jurisdictions and the EU, to show how firms would circumvent complexity prohibitions in the short run. I use a sequential game theory model to show how, in the long run, repeated circumvention would result in regulatory micromanagement of consumer product design. Such micromanagement would increase the cost of enforcement, which firms would pass onto consumers in the form of higher prices as they continue to profiteer from new complexities that are not yet prohibited. Therefore, complexity prohibitions would have defeated their own stated objective of *eliminating* complexities that firms could exploit for profit.

Unlike Part I, which only examines whether complexity prohibitions would achieve their stated goals, Part II expands the inquiry to scrutinize two *normative* assumptions underlying complexity prohibitions. First, how much do consumers really want complexity prohibitions like right-to-repair laws? Many consumer surveys indicate strong support for a right to repair,[29] which advocates cite as a justification for uniform repairability requirements.[30] Yet, consumers' stated preferences for complexity prohibitions seem incongruent with their *revealed* preferences. Studies consistently show that the average consumer replaces electronics like phones and computers well before the end

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[28] Common Rules Promoting the Repair of Goods, COM(2023)0155 – C9-0117/2023 – 2023/0083(COD)) [*EU Right to Repair Law*], art. 7(1) (April 23, 2024), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401799.

[29] *See, e.g.*, Perzanowski, *supra* note 21 at 392 ("More than 80 percent of respondents" support right to repair); Maureen Mahoney & George Slover, *Consumer Reports Survey Finds Americans Overwhelmingly Support the Right to Repair*, CONSUMER REPORTS (Feb. 28, 2022), https://advocacy.consumerreports.org/press_release/consumer-reports-survey-finds-americans-overwhelmingly-support-the-right-to-repair.

[30] *See, e.g.*, Perzanowski, *supra* note 21 at 393 ("[C]onsumers should not be expected to account for [repair restrictions] in their purchasing decisions."). Edward Baker et al., *A Survey to Assess Public Perception of Right to Repair for Electronic Devices*, 23 ISSUES IN INFO. SYS. (2021) ("[P]eople are very supportive of the Right to Repair. . . . [T]his research could be used . . . to introduce new legislation[] that will benefit the Right to Repair.").

of their lifespan[31] "while they are still functioning" for, among other reasons, "fashion"[32]—which does not accord so well with the view that there is such an overwhelming demand for repairability that it must be legislated. Given the diversity of consumer preferences for repairability and the availability of products catering to varying preferences,[33] why must we legislate complexity prohibitions that would force *all* products to uniformly prioritize repairability?

Second, how would complexity prohibitions correctly identify cases of complexity profiteering? Many commentators criticize what they see as instances of complexity profiteering, but they do not explain how complexity prohibitions would objectively discern whether a design feature is intended to facilitate profiteering or to add value for consumers. For example, prominent right-to-repair advocates[34] decried BMW's offer of heated seats for a monthly fee as an attempt to get consumers to pay "indefinitely into the future" for cars they already bought.[35] This was despite the fact that subscription model would save consumers money as long as they do not "subscribe for heated seats all-year round."[36] The point is that even the most well-meaning and informed commentators could be wrong about whether a perceived act of complexity profiteering is indeed an act of profiteering. When complexity prohibitions make that error by banning useful technological applications, they would ban design features that may be value-adding. In contrast, if consumers misjudge a feature as complexity profiteering, they can correct such an error much more easily by reconsidering whether to buy it if and when a firm offers it again.[37]

Of course, consumers must be aware of the options available on the market to take advantage of their buying power. Part III presents this Article's solution to complexity profiteering: to inform consumers about it so that they

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[31] Vijay S. Venkitachalam, Vinod Namboodiri, Siny Joesphy, Emily Dee & Charles A. Burdsal, Jr., *What, Why, and How: Surveying What Consumers Want in New Mobile Phones*, IEEE CONSUMER ELECTRONICS MAGAZINE (2015) ("[T]he average life of a smartphone is five to seven years" but "the actual duration for which a smartphone is used is much fewer.").

[32] Harald Wieser & Nina Tröger, *Exploring the Inner Loops of the Circular Economy: Replacement, Repair, and Reuse of Mobile Phones in Austria*, 172 J. OF CLEANER PRODUCTION 3042, 3043 (2018).

[33] *See supra* notes 26, 27 (smartphone and laptop computer with replaceable batteries with comparable performance to iPhones and MacBooks at similar or cheaper price points).

[34] PERZANOWSKI, *supra* note 16 at 158, 260 (describing Louis Rossmann as a "prominent voice pushing for repair" and an "outspoken independent repair provider and advocate").

[35] Louis Rossmann, *BMW Charging 18/mo for Heated Seats – Cars Implementing Subscription Based Microtransactions*, 02:08, YOUTUBE (Sep. 10, 2023), https://www.youtube.com/watch?v=qJdwbWc-n7g.

[36] Sebastian Cenizo, *BMW Suffers a Major Loss Over Heated Seat Subscription*, CARBUZZ (Sep. 8, 2023), https://carbuzz.com/news/bmw-suffers-a-major-loss-over-heated-seat-subscription/.

[37] *Id*. (BMW representative stating that it will provide subscription services in the future).

vote with their own wallets. The challenge to such an information campaign is not that information on complexity profiteering is unavailable. For many of the best-known brands, consumers have put relevant information online[38] and the platforms hosting the information have shown how to do a serviceable job of fact-checking it. Community Notes, the fact-checking tool used by X (formerly Twitter), has been as high as 97 percent accurate[39] and its algorithm is open-source.[40] The most significant challenge is how to get consumers to find and act on the relevant information in this age of information overload.[41]

I propose a QR code attached to a product's packaging or its website, which would direct consumers to a website of crowdsourced information on whether a product is suspected of complexity profiteering at the touch of a screen. This website, which I call the Buyer Beware Platform (BBP), would resemble the EU's "Online Platform for Repair,"[42] except that the BBP would inform people about which brands require subscriptions for heated seats or glue batteries into phones, instead of "applicable European or national repair quality standards."[43] Although the QR code would initially serve as a gateway to the BBP, it may not actually need to be used given enough time. If the BBP gets a reputation for accuracy, the QR code's mere existence could be proof that a product does not engage in complexity profiteering, thus serving as a cognitive shortcut that spares people from having to look things up. Informing people about complexity profiteering would restore firms' incentive to fear their customers taking their business elsewhere, as evidenced by a resurgent trend of firms promoting a *lack* of complexity profiteering, like monthly fees to remotely start a car.[44] I conclude by proposing a paradigm shift in tech law away from regulatory maximalism and toward a more pragmatic approach which accepts that indirect, market-based solutions may, in at least some instances, provide more control over technology than direct regulation would.

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[38] *See, e.g.*, Joe Pompliano (@JoePompliano), X (July 12, 2022, 9:57 AM), https://twitter.com/JoePompliano/status/1546871470256783361 (criticizing BMW's introduction of monthly or annual subscription for heated seats as "microtransaction hell").

[39] Matthew R. Allen, et al., *Characteristics of X (Formerly Twitter) Community Notes Addressing COVID-19 Vaccine Misinformation*, at E1 J. of Am. Med. Assoc. (Apr. 24, 2024) (the accuracy of Community Notes regarding vaccines for COVID-19).

[40] *Note Ranking Algorithm*, X, *available at* https://communitynotes.x.com/guide/en/under-the-hood/ranking-notes.

[41] *See* KIMIZ DALKIR & REBECCA KATZ, NAVIGATING FAKE NEWS, ALTERNATIVE FACTS, AND MISINFORMATION IN A POST-TRUTH WORLD 24 (2020) ("an abundance of choice makes it more difficult for consumers to make buying decisions.").

[42] *EU Right to Repair Law*, art. 7(1).

[43] *Id*. at art. 7(6)(a).

[44] *Introducing Bluelink+*, HYUNDAI (advertising itself as the "only automaker to give you a full suite of remote [online] services at no additional cost" which "can save you up to $350 or more per year"), *available at* https://www.hyundaiusa.com/us/en/bluelinkplus.

I. AN ANATOMY OF REGULATORY SELF-DEFEAT

What this Article calls complexity profiteering—using technology to make a product more complex to profiteer from the complexity without adding value—may not seem novel at first sight. Complexity profiteering could be seen as a type of rent-seeking, under a very broad definition of that term.[45] Indeed, the motivation for both complexity profiteering and rent-seeking has arguably existed for as long as the profitmaking motive has existed: to milk a moneymaking asset for all that it is worth, whatever the method. But what *is* new about complexity profiteering is how the modern economy can enable it to flourish and make it difficult to counteract. The unprecedented variety and technological sophistication of contemporary consumer products, be they smartphones or home appliances connected to the internet, create a virtually inexhaustible well of complexities to be exploited for profit.[46] The variety and sophistication of consumer products also mean that firms understand and control their own products much better than consumers do[47]—an information asymmetry which is only likely to intensify as technology advances further.

The daunting challenge presented by complexity profiteering stands in contrast to the simplistic nature of an increasingly popular solution: ban the complexities that firms can exploit. Unfortunately, just as banning political opposition does not eliminate it, complexity prohibitions do not prevent firms from circumventing them. In fact, complexity prohibitions are self-defeating in the long run because they facilitate *more* complexity profiteering—just as banning political opposition creates more of it. When the law prohibits some complexity, firms can pick another of the countless number of complexities to exploit for profit. The law would then ban the second complexity, followed by firms picking yet another complexity to exploit. As this whack-a-mole continues ad infinitum, the loopholes opened and the laws enacted in order to close them would cumulatively amount to regulatory micromanagement and complication of how firms design their products. This overcomplication of the design process would provide more complexities for firms to exploit,

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[45] MICHAEL L. ROSS, TIMBER BOOMS AND INSTITUTIONAL BREAKDOWN IN SOUTHEAST ASIA 33 (2001) ("Rent seeking is sometimes defined as any effort by private actors to capture economic rents, in a manner that is socially unproductive.").

[46] *See* STACY-ANN ELVY, A COMMERCIAL LAW OF PRIVACY AND SECURITY FOR THE INTERNET OF THINGS 327 (2021) ("[M]any IoT companies have flooded the consumer market with . . . devices that rely on software, services, and external systems to function, . . . using their ability to innovate to retain control over us and our devices post transaction.").

[47] *See* DALKIR & KATZ, *supra* note 41 (variety of product choices); LINDA R. SINGER, SETTLING DISPUTES: CONFLICT RESOLUTION IN BUSINESS, FAMILIES, AND THE LEGAL SYSTEM 86-87 (2d ed. 2018) ("Consumers may feel ignorant about the technical aspects of products or services, particularly cars [and] appliances . . . . People may be intimidated by their ignorance or feel powerless in comparison with . . . knowledgeable[] corporations").

thus defeating the entire point of complexity prohibitions: to *reduce* design features that firms can exploit for profit. Part I presents this argument using bills, laws, examples of firm behavior, and a sequential game theory model.

A. Circumvention in the Short Run: Just Pick Another Complexity

Although BMW's attempt to charge monthly fees for heated seats was limited to particular countries,[48] public reaction to the attempt was not. Conventionally, buying a car was understood as acquiring total control—the right to make full use of whatever hardware that came with the car trim.[49] But BMW's new business model seemed to indicate that a firm could remotely lock the hardware it already handed over to customers to monetize it further, calling into question whether consumers really owned the cars they bought.[50] State legislatures in the United States soon vowed to crack down, specifically citing the example of BMW "requiring subscriptions for heated seats" despite its cars having all "necessary equipment installed at the time of purchase."[51] As of the time of writing, bills with the following language, either verbatim or with minor changes in wording that do not affect substance, had come before the legislatures of Arizona, California, Idaho, Illinois, Massachusetts, New Jersey, New York, Tennessee, Washington, and West Virginia:

> (5) "Motor vehicle feature" shall mean any convenience or safety function included on the motor vehicle, including but not limited to heated seats or driver assistance, that typically is offered to a consumer as an upgrade at the time of purchase or lease of the motor vehicle.
>
> (6) "Subscription service" shall mean a service provided on a subscription basis in exchange for a recurring payment,

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[48] *See* Valdes-Dapena, *supra* note 1 (heated seat program offered in the United Kingdom).

[49] *See, e.g.*, *Honda Pilot Continues the Adventure with a Host of Additions for 2004*, HONDA (Oct. 6, 2003) ("Pilot EX models with leather interior (EX-L) add heated seats" as "standard features for 2004"), *available at* https://hondanews.com/en-US/releases/release-a84c40fcc288d2b111ce7c004c34c499-honda-pilot-continues-the-adventure-with-a-host-of-additions-for-2004; *Honda Passport Improved for 2024: More Capable, More Comfortable, More Style*, HONDA (Oct. 4, 2023) (Black Edition has "heated rear seats"), *available at* https://hondanews.com/en-US/honda-automobiles/releases/release-cc39196e84787a20ec3cb086fb016ecc-honda-passport-improved-for-2024-more-capable-more-comfortable-more-style.

[50] *See* Charlton, *supra* note 22 ("People feel that they paid double" for heated seats).

[51] Sen. Marty Flynn, *Banning In-Car Subscriptions for Hardware Features on Motor Vehicles*, Senate Co-Sponsorship Memorandum, (Mar. 21, 2023), *available at* https://www.legis.state.pa.us/cfdocs/Legis/CSM/showMemoPublic.cfm?chamber=S&SPick=20230&cosponId=40247.

> including, but not limited to, a weekly, monthly, or annual payment charged to and made by a consumer . . . .
>
> (b) No manufacturer, dealer, or agent of a manufacturer or dealer shall offer to a consumer a subscription service or charge a post-purchase fee for any motor vehicle feature that:
>
> (1) utilizes components and hardware already installed on the motor vehicle at the time of purchase . . . and . . . would function after activation without ongoing expense to the dealer, manufacturer, or any third-party service provider.[52]

The subscription ban covers a far wider range of features than just heated seats. "[A]ny convenience or safety function . . . that typically is offered . . . as an upgrade at the time of purchase"[53] can include blind spot monitors, parking assist, traffic alert, and keyless entry, among others.[54] The broad scope of the bill can also cover features that have not even been invented yet. This may make the bill appear to be a future-proof solution to firms engaging in complexity profiteering by selling vehicle features on a subscription basis.

Unfortunately, firms appear to have defeated this ban even before it became law, by choosing a different complexity to exploit. On April 26, 2023, Mercedes-Benz announced that it would offer faster acceleration for a monthly, annual, or lump-sum payment.[55] The upgrade would "utilize[] . . . hardware already installed on the motor vehicle at the time of purchase" and would be sold for a "subscription" or a "post-purchase fee," which the bill prohibits.[56] Nevertheless, faster acceleration would likely avoid the bill's ban on post-purchase sales because it is unlikely to qualify as a "convenience or safety function," such as "heated seats or driver assistance."[57] Acceleration affects a car's performance, not safety or convenience, in that it reduces the

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[52] 2023 New York Senate Bill No. 8393 (April 12, 2024). *See also* 2023 California Assembly Bill No. 473 (Feb. 6, 2023); 2023 Illinois House Bill No. 2047 (Feb. 2, 2023); 2024 New Jersey Senate Bill No. 1282 (Jan 9. 2024); 2023 Massachusetts Senate Docket No. 2152 (Jan. 20, 2023); 2023 Tennessee House Bill No. 651 (Jan. 30, 2023); 2024 Idaho House Bill No. 642 (Feb. 23, 2024); 2023 West Virginia Senate Bill No. 462 (Jan. 24, 2023); 2024 Ariz. House Bill No. 2410 (Jan. 11, 2024); 2023 Wash. House Bill No. 2028 (Dec. 22, 2023).

[53] 2023 New York Senate Bill No. 8393 (April 12, 2024).

[54] *See, e.g.*, Nikesh Kooverjee, *2024 Toyota Prius Prime: A Comprehensive Guide on Features, Specs, and Pricing*, TOPSPEED (Nov. 8, 2023), *available at* https://www.topspeed.com/2024-toyota-prius-prime-overview/.

[55] *See* MERCEDES-BENZ, *supra* note 18.

[56] *See id*. ("Customers can experience [the acceleration increase option] . . . online . . . . without . . . a trip to a dealership."); 2023 New York Senate Bill No. 8393 (April 12, 2024).

[57] 2023 New York Senate Bill No. 8393 (April 12, 2024).

time needed to go from zero to sixty.[58] It is also questionable whether faster acceleration qualifies as a feature "that typically is offered to a consumer as an upgrade at the time of purchase,"[59] as acceleration is usually not offered as an upgrade.[60] Mercedes' disclaimer that "features[] such as heated seats[] will not be offered as digital extras"[61] also indicates an intent to avoid bans on subscription sales of heated seats, showing that complexity prohibitions can be circumvented by choosing a different complexity to exploit for profit.

This example may seem to be evidence of the flaws of a specific bill only, because the loophole would not exist if the law banned *all* car features from being sold by subscription. But this example represents a problem with complexity prohibitions generally because it illustrates the sheer difficulty of finding a Goldilocks zone between over- and underinclusive bans of specific features. If references to specific features were jettisoned in order to prevent circumvention, the prohibition would become so broad as to ban things that consumers may want. If, on the other hand, the ban applied only to specific features to avoid overinclusion, firms would circumvent it. The difficulty of finding a workable midpoint between the two extremes is due to fact that firms know how to exploit their own products for profit better than the state does. For the avoidance of any doubt, the observation that a firm knows its own business better than regulators do is not a political statement in the way that, for instance, "Americans know how to spend their own money better than politicians do"[62] indicates a particular ideological belief. Rather, saying that "the firm will know more about its costs and its opportunities than will the regulator"[63] is merely an objective statement of generally applicable fact.

Another example of how the above-cited bill can be circumvented illustrates further how firms' information advantage over regulators forces complexity prohibitions to be either over- or underinclusive and likely to err on the side of underinclusion, thus enabling firms to easily circumvent them. The bill's subscription ban only affects features that "would function after activation without ongoing expense to the dealer, manufacturer, or any third-party service provider."[64] This exemption must exist not only in this bill, but

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[58] *See* MERCEDES-BENZ, *supra* note 18 (reducing zero to sixty by 0.8 to one second).

[59] 2023 New York Senate Bill No. 8393 (April 12, 2024).

[60] *See, e.g.*, Jeff Perez, *Maserati MC20 Sports Car Revealed With 621 HP And An EV Option*, MOTOR1.COM (Sep. 9, 2020) ("gas, electric, and convertible" options with fixed acceleration), *available at* https://www.motor1.com/news/443069/maserati-mc20-sports-car/.

[61] *See* MERCEDES-BENZ, *supra* note 18.

[62] 131 CONG. REC. H1,791 (daily ed. April 18, 2023) (statement of Rep. Andy Biggs).

[63] GLENN BLACKMON, INCENTIVE REGULATION AND THE REGULATION OF INCENTIVES 6 (1994) ("[A]n inevitable consequence of having a private firm responsible for production is that the firm will know more about its costs and its opportunities than will the regulator").

[64] 2023 New York Senate Bill No. 8393 (April 12, 2024).

also in any complexity prohibition. If the ban applied to features that *do* create ongoing costs, it would prohibit features that consumers may want but firms would sell only by subscription to cover those costs: for example, Toyota sells a navigation service that claims to provide "up-to-date routes and estimated times of arrival" "through real-time updates downloaded from the cloud."[65]

It is this type of unavoidable exemption that enables firms to defeat complexity prohibitions wholesale. In 2021, Toyota announced that it would charge a monthly fee of $8 for a feature that used to be free: the ability to start a car remotely with a key fob.[66] The remote start function "has nothing to do with an app, nor does the car or the fob communicate with any servers managed by Toyota"[67]—meaning that it utilizes hardware sold up front, does not create any ongoing cost for Toyota, dealers, or other third parties, and thus that it falls squarely in the definition of features that cannot be sold via subscription. But firms can easily circumvent this ban by inserting an app or server so that there *is* a nominal ongoing cost. That is what Toyota appears to have done: as of 2025, Toyota charges $15 to $25 monthly for a set of features including Remote Connect, which is "available through the Toyota App" and allows users to "[s]tart, lock/unlock your doors . . . using your compatible smart device."[68] While this loophole could theoretically be closed by expanding the subscription ban to include features that do incur ongoing costs, that would likely resurrect the risk of banning things that consumers might want. For example, Toyota's online app permits an owner to lock car doors from anywhere on Earth, whereas key fobs perform the same function only within a car's visible distance.[69] In sum, firms can defeat complexity prohibitions in the short run just by picking a different complexity to exploit.

B. Self-Defeat in the Long Run: Regulatory Whack-a-Mole

The fact that firms circumvent complexity prohibitions in the short run does not stop regulators from closing each loophole as it is opened in the long run, piecemeal. This is how the European Union's forthcoming right-to-repair law would operate. Under the law, "upon the consumer's request,

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[65] *What Are the Features of Dynamic Navigation?*, TOYOTA, https://support.toyota.com/s/article/What-are-the-features-9816?language=en_US.

[66] Tim De Chant, *Toyota Owners Have to Pay $8/mo to Keep Using Their Key Fob for Remote Start*, ARS TECHNICA (Dec. 13, 2021), *available at* https://arstechnica.com/cars/2021/12/toyota-owners-have-to-pay-8-mo-to-keep-using-their-key-fob-for-remote-start/.

[67] *Id.*

[68] *Audio Multimedia and Connected Services*, TOYOTA, https://www.toyota.com/connected-services/.

[69] *See Remote Connect*, TOYOTA, https://www.toyota.com/connected-services/remote-connect.

the manufacturer shall repair goods for which . . . repairability requirements are . . . listed in Annex II,"[70] a list that would be updated with additional "repairability requirements" in response to "regulatory developments."[71] But this regulatory whack-a-mole would fail because firms would circumvent each new complexity prohibition as it is enacted. Firms would continue to engage in complexity profiteering through a costly and circuitous process of intentionally complicating product design, to circumvent the growing list of design restrictions. Ultimately, complexity prohibition becomes regulatory micromanagement of product design, which would create more complexities and defeat the original goal of *eliminating* complexities that firms can exploit.

The idea of a right to repair gained public support as firms came under suspicion of engaging in complexity profiteering. In 2017, Apple released software updates that intentionally slowed down old iPhone models without disclosing that fact, until users noticed.[72] Critics accused Apple of slowing down older iPhones to "push[] users to unnecessarily buy new phones,"[73] a claim that led to a class action suit and its eventual settlement.[74] If Apple was indeed engaging in complexity profiteering, sabotaging older iPhones was a rather ham-handed way of doing it. Since then, Apple seems to have adopted the subtler strategy of making their products more complex for a plausibly defensible reason—such as making the iPhone more water-resistant—which also makes repair such as battery replacement difficult,[75] thus incentivizing consumers to buy a new product even though repairing an old one may suffice. Rising suspicions that firms were deliberately obstructing repair gave public support to the idea of a consumer's right to easily repair certain products.[76]

Parts pairing is a practice often identified as giving firms plausible deniability for thwarting repair. For example, Apple has put serial numbers

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[70] *EU Right to Repair Law*, art. 5(1).

[71] *Id*. at art. 5(9).

[72] *In re Apple Inc. Device Performance Litig.*, 50 F.4th 769, 776 (9th Cir. 2022).

[73] Richard Lawler, *Apple's iPhone 'Batterygate' Settlement Payments Should Start Going Out Soon*, THE VERGE (Aug. 14, 2023), *available at* https://www.theverge.com/2023/8/14/23831939/apple-iphone-batterygate-iphone-6-7-se-battery-performance-lawsuit.

[74] *In re Apple Inc. Device Performance Litig.*, No. 23-15416, 2023 WL 10447843, at *1 (9th Cir. Aug. 8, 2023) (appeal voluntarily dismissed).

[75] *See* ORBIT, *Sustainability Interview with John Ternus & Lisa Jackson from Apple!*, YouTube (July 6, 2023), https://www.youtube.com/watch?v=1VQ1Oll8-7A (Apple's senior vice president of hardware engineering arguing that making components more easily removable may make it harder to make a product more water-resistant).

[76] *See, e.g.*, Emanuele S. Putrino, *Tesla, Let Me Fix My Car: The Right to Repair and the Need for a Balance Between Public and Private Enforcement*, 76 OKLA. L. REV. 351, 354 (2024) (arguing that consumers perceived Tesla's car repair policies to be "nefarious schemes to discourage . . . repair and to incentivize the purchase of new vehicles").

on a product and its various components such as an iPhone and its battery.[77] Apple uses software to bind the serialized components to the product so that only Apple can replace any; if done without Apple's approval, "[s]wapping components between the same model [of genuine iPhones] . . . may disable certain features," such as the camera, battery health display, and FaceID.[78] Although Apple has defended parts pairing as "critical to preserving the privacy, security, and safety of iPhone,"[79] it was also true that parts pairing gave Apple a virtual monopoly on repairing iPhones, with the concomitant power to raise prices or attach other conditions so as to discourage repair.[80] On March 27, 2024, Oregon enacted a law that would require firms to provide to consumers any tools or parts required for repair at cost[81] and ban parts pairing starting in 2027.[82] After some resistance,[83] Apple announced that it would relax parts pairing.[84] Apple also announced an expansion of its self-service repair program to give users "access to the same manuals, . . . parts, and tools used [by] Apple," so users can repair Apple products themselves.[85]

But the Oregon law would not force Apple to make repair as easy as its proponents argue[86] because Apple can easily erect other barriers to repair.

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[77] *The iPhone 14 Continues Apple's Digital Repair Lockdown*, IFIXIT (Oct. 19, 2022) https://www.ifixit.com/News/66879/iphone-14-parts-pairing-results-apple-is-still-trying-to-monopolise-repair.

[78] *Id*. (no battery health displayed; front camera disabled; FaceID no longer available).

[79] *See Apple to Expand Repair Options with Support for Used Genuine Parts*, APPLE, https://www.toyota.com/connected-services/remote-connect.

[80] *See* European Economic and Social Committee, Opinion, INT/1015 – EESC-2023-01158-00-00-AC-TRA-EN ¶ 4.3.3 (June 14, 2023) (Parts pairing permits only the manufacturer or its certified agents to perform repairs), https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/right-repair; *see id*. at ¶ 1.7 (discussing cases where parts pairing is "applied in order to obstruct competition in the spare parts market").

[81] OR LEGIS 69 (2024), 2024 Oregon Laws Ch. 69 § 1(1)(d)(B) (S.B. 1596).

[82] *Id*. at § 1(2)(b) (banning parts pairing intended to "[p]revent or inhibit" repair); *id*. at § 5 (enforcement applies to violations of the law committed on or after July 1, 2027).

[83] *See, e.g.*, OR State Senator Janeen Sollman, *Right to Repair (SB 1596) Public Hearing*, YouTube (Feb. 9, 2024), https://www.youtube.com/watch?v=PwcN0rbcB8E (1:02:55) (John Perry, Apple's senior manager for secure system design, testifying against the provision banning parts pairing in Oregon's proposed right to repair law, S.B. 1596).

[84] *Apple to Expand Repair Options with Support for Used Genuine Parts*, APPLE, https://www.apple.com/newsroom/2024/04/apple-to-expand-repair-options-with-support-for-used-genuine-parts/.

[85] *Apple Expands Self Service Repair for Mac, Adds Diagnostics, and Updates System Configuration*, APPLE, https://www.apple.com/newsroom/2024/02/apple-expands-self-service-repair-for-mac.

[86] Lynne Terry, *Oregon Becomes Fourth State with a "Right to Repair" Law for* Technology, OREGON CAPITAL CHRONICLE (Mar. 27, 2024) (advocacy group stating that "[n]o longer can a manufacturer use anti-consumer software to prevent third party repairs"), https://oregoncapitalchronicle.com/2024/03/27/oregon-becomes-fourth-state-with-a-right-

Replacing the battery in an iPhone 6, for example, required removing a panel held by screws and clips.[87] In the iPhone 16, the equivalent part is held by screws, clips, and adhesives.[88] The tools provided by Apple for melting the adhesives and replacing the battery "come[] in cases that, when stacked on top of each other, measure 20 inches wide and 47 inches high," weighing 79 pounds.[89] If the heat required to melt the adhesive is applied improperly, it can damage the battery, which is flammable.[90] Unsurprisingly, some users who tried replacing iPhone batteries commented that "Apple doesn't want us to repair" them, and that they wanted to "abort[] the entire process before Apple ever shipped 79 pounds of equipment."[91] While the Oregon law bans parts pairing and requires manufacturers to provide repair equipment at cost, it does nothing to prevent Apple from designing their products or tools in ways that make repair infeasible in practice. Even if legislators thought to prevent such behavior, that would have effectively required the government to micromanage the myriad aspects of Apple's product design in real time.

The prospect of having to outwit firms like Apple at their own game does not appear to have deterred the European Union, whose forthcoming right to repair law would counter circumventions of specific requirements by adding more specific requirements. The law presents behavioral and design restrictions aimed at making repair easier. Repairs must be performed "free of charge or for a reasonable price" and, when a manufacturer performs the repair, "within a reasonable period of time from the moment" access to the product to be repaired has been obtained.[92] Firms must provide "spare parts and tools . . . at a reasonable price that does not deter repair."[93] Firms are also prohibited from using "any contractual clauses, hardware or software

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to-repair-law-for-technology/; Lauren Drake, *Oregon 'Right to Repair' Bill Passes State Senate*, OREGON PUBLIC BROADCASTING (Feb. 20, 2024) (State Senator Janeen Sollman stating that the bill would give consumers "affordable and sustainable options" for repairing electronics), https://www.opb.org/article/2024/02/20/oregon-right-to-repair-devices-bill/.

[87] *iPhone 6 Battery Replacement*, IFIXIT, *available at* https://www.ifixit.com/Guide/iPhone+6+Battery+Replacement/29363.

[88] *iPhone 16 Battery Replacement*, IFIXIT, *available at* https://www.ifixit.com/Guide/iPhone+16+Battery+Replacement/177286.

[89] SELF SERVICE REPAIR STORE, *Tool Kit Rental*, https://www.selfservicerepair.com/en-US/tool-kit-rental.

[90] *See iPhone 16 Battery Replacement*, *supra* note 88; *Important Safety Information for iPhone*, APPLE, https://support.apple.com/guide/iphone/important-safety-information-iph301fc905/ios ("An iPhone battery . . . damage . . . could cause overheating [or] fire.").

[91] Sean Hollister, *Apple Shipped Me a 79-Pound iPhone Repair Kit to Fix a 1.1-Ounce Battery*, THE VERGE (May 21, 2022), *available at* https://www.theverge.com/2022/5/21/23079058/apple-self-service-iphone-repair-kit-hands-on.

[92] *EU Right to Repair Law*, art. 5(2)(a), 5(2)(b).

[93] *Id*. at art. 5(4).

techniques that impede the repair of goods" such as "imped[ing] the use of original or second-hand spare parts" unless doing so would be "justified by legitimate and objective factors,"[94] which clearly refers to parts pairing and anything else that achieves similar results. In addition, the law states, "upon the consumer's request, the manufacturer shall repair goods for which . . . repairability requirements are provided for . . . in Annex II," a list that would be updated in light of "regulatory developments."[95] This provision, the European Commission submits, would render the law "future-proof."[96]

The EU right to repair law shows how complexity prohibitions can defeat themselves in the long run because firms would complicate product design to circumvent the law's many restrictions, resulting in an *increase* in exploitable complexities that the law is meant to reduce. If Apple can no longer incentivize people to buy new products by *preventing* repairs, Apple could force people to perform more expensive repairs than they need—thus prompting rational consumers to ask why they wouldn't just get a shiny new model. Apple's MacBook Pro is designed in precisely this way. According to the manual, replacing the battery for the 14-inch, M3, November 2023 MacBook Pro requires replacing not only the battery, but also the keyboard, microphone, and speakers because all four components are bound to the top case and "there are no additional removal steps."[97] The top case assembly costs $527.12, about 33 percent of the sticker price of that MacBook Pro model.[98] Apple does not have to engage in parts pairing, ship out 79-pound toolkits, or apply glue[99] to incentivize people to forgo repair for a purchase. The EU law would likely incentivize Apple to adopt this excessive repair tactic more liberally,[100] thus overcomplicating product design and defeating the law's own goal of *reducing* complexities that firms can exploit for profit.

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[94] *Id*. at art. 5(6).

[95] *Id*. at art. 5(1), 5(9).

[96] European Commission, *'Right to Repair': Questions & Answers* (Mar. 22, 2023), *available at* https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_1795.

[97] *MacBook Pro (14-inch, M3 Pro or M3 Max, Nov 2023) Top Case with Battery and Keyboard*, APPLE, https://support.apple.com/en-us/103925.

[98] *Choose Your New MacBook Pro*, APPLE, https://www.apple.com/shop/buy-mac/macbook-pro/14-inch-m3 (14-inch M3 model costs $1,599 as of April 29, 2024); SELF SERVICE REPAIR STORE, *Filter by device / repair type*, https://www.selfservicerepair.com/en-US/tool-kit-rental. Apple's official self-service repair website, which shows the price of components for MacBooks, cannot be archived because access requires entering the relevant product's serial number. A printed copy of the webpage showing the price of the top case as of April 29, 2024 is on file with the author.

[99] *See* APPLE, *supra* note 91 ("No tools are required for this procedure"); *EU Battery Directive*, art. 11 (requiring free provision of tools required to melt any adhesives).

[100] Some older MacBook models permitted replacement of the battery only. *See MacBook Air (M1, 2020) Battery*, APPLE, https://support.apple.com/en-us/100600.

It may seem that the EU law accounts for the excessive repair tactic, because the law prohibits "any . . . hardware . . . techniques that impede . . . repair" and requires firms to provide "spare parts . . . at a reasonable price that does not deter repair."[101] While "any" technique can be interpreted to include the excessive repair tactic, this provision could not, in practice, be enforced against anything but the most obvious and egregious instances of that tactic. For repair to be practical, firms must provide assemblies of parts, not each individual part: a single key in a keyboard would likely be useless to the typical consumer or third-party technician looking to replace a water-damaged laptop keyboard. If the EU wishes to prevent firms from providing excessively expensive assemblies of parts, it will inevitably have to draw a line past which such an assembly exceeds "a reasonable price that does not deter repair."[102] How would the EU, or indeed any other regulator, set a "reasonable" price limit for each of the countless number of products on the market, given the immutable engineering differences that may make repair inherently cheaper for some products than for others?[103] Assuming arguendo that regulators could accomplish such a herculean task at any one instance, how would regulators keep up with developments in all of those products a timely manner? Complexity prohibitions cannot be saved from self-defeat by simply adding more, because complexity prohibitions require regulators to micromanage and outwit firms at their own dauntingly complex game.[104]

One may argue that the EU need not set price limits for every single product before the fact. This may be because the EU could make case-by-case rulings as to whether the price set by a firm to repair a product is "justified by legitimate and objective factors"[105] without explaining such rulings using objectively discernible standards. Indeed, even when the EU *has* objectively discernible standards, it has defied them without meaningfully justifying the decision. For example, even though Samsung met the numerical thresholds for a company to be regulated by the Digital Markets Act, the EU exempted Samsung because it made unspecified "justified arguments."[106] In contrast, "despite not meeting the quantitative thresholds laid down by the DMA,"

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[101] *EU Right to Repair Law*, art. 5(4), 5(6).

[102] *Id*. at art. 5(4).

[103] MICHEL MILLOT, EMBARRASSMENT OF PRODUCT CHOICES 1: HOW TO CONSUME DIFFERENTLY 50 (2018) ("*Technological sophistication* involves more frequent failures and more complex repairs. . . . [F]or example, the cathode ray tubes found in older TV sets had an average lifespan of 10-15 years, while a flat screen TV lasts about 5 years.").

[104] *See* Deirdre K. Mulligan & Kenneth A. Bamberger, *Saving Governance-by-Design*, 106 CALIF. L. REV. 697, 701 (2018) ("Agencies generally lack . . . the technical expertise . . . to consider fully the implications of embedding values in [technological] design.").

[105] *EU Right to Repair Law*, art. 5(6).

[106] European Commission Press Release IP/23/4328, *Digital Markets Act: Commission Designates Six Gatekeepers* (Sep. 6, 2023).

Apple's iPadOS was designated as a regulated entity because, among other reasons, Apple was "predicted" to hit a key threshold "in the near future."[107]

Setting aside the evidently arbitrary nature of this ad hoc scheme from a jurisprudential perspective, it would still be impractical if used to enforce the EU's right to repair law. Products such as computers or phones can take years to develop until release, and whether the cost of repair "does not deter repair"[108] can depend on a product's design, as the example of the MacBook Pro shows.[109] Without an objectively discernible standard that enables firms to predict how regulators will react, firms may not risk developing products for the single market for fear that the release will be met with enforcement actions under the right to repair law. Therefore, unless the EU is willing to accept firms releasing intentionally downgraded versions of their products to avoid violations[110] or even exiting the single market,[111] firms will likely circumvent the EU's right to repair law by overcomplicating their product design, which would in turn force that law to defeat itself in the long run.

Even examples of complexity prohibitions pointed to as successes, in actuality, demonstrate how they can be circumvented and make products even more complex, thus providing other complexities for firms to exploit. Before Apple launched the iPhone 15 in September 2023, iPhones used the proprietary Lightning cable for charging and data transfer, which works only for Apple products.[112] In contrast, most contemporaneous non-Apple devices, regardless of brand, use the Universal Serial Bus (USB) Type C cable.[113] The Lightning cable's exclusivity prevented iPhone purchasers from using spare

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[107] European Commission Press Release IP/24/2363, *Commission Designates Apple's iPadOS Under the Digital Markets Act* (April 29, 2024).

[108] *EU Right to Repair Law*, art. 5(4).

[109] *See supra* notes 97-100 and accompanying text.

[110] *See* Richard Waters, *The EU's Giant Experiment in Tech Micromanagement*, FINANCIAL TIMES (March 7, 2024) ("For Google . . . complying with the [Digital Markets Act] means downplaying its own 'vertical' search features . . . . [which] for users . . . will mean an extra step in reaching a final result"), https://www.ft.com/content/03f8c8f5-a968-4060-a5b1-a62b225fb39b.

[111] *See* Yunsieg P. Kim, *A Revolution Without a Cause: The Digital Markets Act and Neo-Brandeisian Antitrust*, 2023 WIS. L. REV. 1247, 1295-96 (2023) (discussing the risk of the Digital Markets Act prompting tech companies to exit the internal market).

[112] *See* Brian X. Chen, *How to Navigate Apple's Shift From Lightning to USB-C*, N.Y. TIMES (Sep. 12, 2023), *available at* https://www.nytimes.com/2023/09/12/technology/personaltech/apple-iphone-lightning-usb-c.html.

[113] *See* Shreyas Sen, *What Is USB-C? An Engineer Explains This One Device Connector to Rule Them All*, PBS (Sep. 17, 2023) (USB-C is "the connector of choice for most non-Apple devices."), *available at* https://www.pbs.org/newshour/science/what-is-usb-c-an-engineer-explains-this-one-device-connector-to-rule-them-all.

USB-C cables that they already had lying around.[114] Moreover, the Lightning cable that Apple included with a new iPhone was only three feet long, prompting many users to purchase a second, longer cable.[115] Apple advised users to buy only from Apple or Apple-certified third parties, citing risks of device damage from charging cables sold by independent manufacturers.[116]

In October 2022, the European Union adopted a directive requiring all mobile phones sold in member states to use USB-C charging cables from December 28, 2024.[117] According to officials, the directive would eliminate the need to "have at least three mobile phone chargers at home,"[118] thereby creating "around €250 million of savings to consumers annually."[119] The directive would eventually cover not only smartphones, but also nearly all portable devices, seemingly preempting any future attempts by Apple at complexity profiteering involving charging cables: "tablets, digital cameras, handheld videogame consoles, headphones, headsets, portable speakers, e-readers, keyboards, mice, portable navigation systems, and earbuds," and laptop computers.[120] With the iPhone 15's adoption of USB-C cables, major press outlets declared that the European Union had "[w]on" against "the world's most valuable company."[121] It seemed that we did away with an "outrageous and dysfunctional Apple profit-padder[]," to enjoy the "societal benefits" of "a single connective standard for all mobile devices."[122] This

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[114] *See* Chen, *supra* note 106 ("[M]ost of us already have a USB-C cable . . . . The iPhone was one of the holdouts.").

[115] *See* Angela Lashbrook, *Do Yourself a Favor and Buy That Longer Charging Cable*, MEDIUM (Feb. 19, 2020), *available at* https://onezero.medium.com/do-yourself-a-favor-and-buy-that-longer-charging-cable-12c7680418cd#.

[116] *See Identify Counterfeit or Uncertified Lightning Connector Accessories*, APPLE (warning against third-party manufactured cables), https://support.apple.com/en-us/111103.

[117] Council of the European Union Press Release 884/22, *Common Charger: EU Ministers Give Final Approval to One-Size-Fits-All Charging Port* (Oct. 24, 2022); Directive (EU) 2022/2380 of the European Parliament and of the Council of 23 November 2022 Amending Directive 2014/53/EU on the Harmonisation of the Laws of the Member States Relating to the Making Available on the Market of Radio Equipment [*EU Common Charging Directive*], 2022 O.J. (L 315) 30, 39 art. 2(1).

[118] Council of the European Union Press Release 884/22, *supra* note 111.

[119] Theirry Breton, *#StrategicAutonomics: W . . . for Waste*, LINKEDIN (Sep. 9, 2023), *available at* https://www.linkedin.com/pulse/strategicautonomics-w-waste-thierry-breton/.

[120] *Id*.

[121] Ben Cohen, *He Took on the World's Most Valuable Company—and Won*, WALL ST. J. (Oct. 3, 2023), *available at* https://www.wsj.com/tech/apple-iphone-15-usb-c-eu-malta-4240a5b3; *see also* Chris Vallance & Zoe Kleinman, *New iPhone, New Charger: Apple Bends to EU Rules*, BBC (Sep. 4, 2023), https://www.bbc.com/news/technology-66708571.

[122] *Editorial: We'll Back Apple Against the Chinese Any Day, But No One Will Miss That Cursed Lightning Charger*, CHICAGO TRIBUNE (Sep. 12, 2023), *available at* https://www.chicagotribune.com/2023/09/12/editorial-well-back-apple-against-the-chinese-any-day-but-no-one-will-miss-that-cursed-lightning-charger/.

view was shared by academics, who described "the new USB-C iPhones [as] a win for consumers"[123] and that it is "hard to conceive of any way in which a consumer is worse off" due to the EU's imposition of USB-C cables.[124]

Unfortunately, the EU law leaves intact many other complexities that Apple can exploit, so as to extract even more profit than it might have without the law. The EU law only forces Apple to change the *shape* of the iPhone cable from Lightning to USB-C.[125] Nothing in the law stops Apple from limiting how fast iPhones can transfer data regardless of the shape of the cable being used, which is what Apple did. The iPhone 15 Pro and Pro Max models use the USB 3 version of USB-C, which transfers data at 10 gigabytes per second.[126] The base iPhone 15 and Plus models, in contrast, use the USB 2 version from 2000, which transfers data at 480 megabytes per second, or 4.8 percent of the speed of USB 3.[127] Yet, Apple is compliant with the EU law because the *shape* of the cable socket—USB-C—is identical for all four iPhone 15 models.[128] The speed differential would be a strong incentive for iPhone buyers to spend the additional $200 or $300 for a Pro or Pro Max,[129] whereas the same buyers might have bought a base or Plus model and an extra Lightning cable for $29[130] if not for the fact that the EU law seems to have caused Apple to differentiate data transfer speeds for different iPhone models.[131] The EU appears to have noticed this unintended consequence only

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[123] Cesareo Contreras, *The USB-C Charging Port on the New iPhone 15 Is a Major Win for Consumers, Expert Says*, NORTHEASTERN GLOBAL NEWS (Sep. 14, 2023) (Prof. Elettra Bietti commenting on the EU common charger directive), *available at* https://news.northeastern.edu/2023/09/14/iphone-15-charger-eu-legislation/.

[124] Cesareo Contreras, *European Regulators Are Cracking Down on Alphabet, Apple and Meta. Will That Have an Impact on How Their Products Work Around the World?*, NORTHEASTERN GLOBAL NEWS (Mar. 28, 2024) (Prof. John Kwoka on the EU directive), *available at* https://news.northeastern.edu/2023/09/14/iphone-15-charger-eu-legislation/.

[125] *EU Common Charging Directive*, art. 1 (requiring compliance with Annex I for applicable devices by December 28, 2024); *id.* at Annex Ia.1.1 ("handheld mobile phones"); *id*. at Annex Ia.2. (requiring devices to "be equipped with the USB Type-C receptable, as described in the standard EN IEC 62680-1-3:2021"); BS EN IEC 62680-1-3:2021 at page 34, 2.2 (defining "USB 2.0 Type-C receptacle for USB 2.0 platforms and devices").

[126] *iPhone 15 Pro Specifications*, APPLE, https://www.apple.com/iphone-15-pro/specs/.

[127] *iPhone 15 Specifications*, APPLE, https://www.apple.com/iphone-15/specs/; ROBERT BRUCE THOMPSON & BARBARA FRITCHMAN THOMPSON, PC HARDWARE IN A NUTSHELL 13 (2003) (USB 2 "finalized in early 2000" with "speeds up to 480 [mpbs]").

[128] *See supra* notes 121-27 and accompanying discussion.

[129] *See* Matt Elliott, *Is the Apple iPhone 15 Pro Worth It Compared to iPhone 15? Here's Our Take*, CNET (Sep. 16, 2023) (citing the difference in data transfer speed as an advantage for the iPhone 15 Pro), *available at* https://www.cnet.com/tech/mobile/is-the-apple-iphone-15-pro-worth-it-compared-iphone-15-heres-our-take/.

[130] *Lightning to USB Cable (2 m)*, APPLE, https://www.apple.com/shop/product/MD819AM/A/lightning-to-usb-cable-2-m.

[131] *See* Sam Rutherford, *Apple's Switch to USB-C on the iPhone 15 Brings More Cable*

after finalizing the law, as indicated by reports in 2023 that the EU had threatened to ban the sale of any device that limits transfer speeds and is planning to write an authoritative interpretation of the law to end evasion.[132]

Moreover, it is unclear whether the EU law would eliminate the need to "have at least three mobile phone chargers at home" as European officials say[133] because, despite the change in the iPhone 15's charging socket, only a certain type of chargers may be compatible. The iPhone 15's release was met with reports that it was "almost too hot to touch" while charging.[134] According to Apple, "larger USB-C power adapters, those above 20W [the wattage recommended by Apple for all four iPhone 15 models]" can cause overheating.[135] Even after Apple reportedly resolved the overheating issues resulting from charging through software updates, users continued to report third-party produced USB-C cables melting and burning the iPhone 15.[136]

None of this is to argue that all, or even most, design and behavioral regulations are futile. Unlike complexity prohibitions, regulations that are narrowly tailored to achieve a well-defined goal are not so easily defeated. For example, many states have minimum and maximum ground clearance requirements for vehicles.[137] If a car is too close to the ground, it would be damaged from debris or fixtures such as rocks or rail tracks.[138] If a car is too

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Confusion, ENGADGET (Sep. 13, 2023) (Apple's switch from Lightning to USB-C "may have been motivated more by EU regulations than a desire to increase usability"), *available at* https://www.engadget.com/apples-switch-to-usb-c-on-the-iphone-15-brings-more-cable-confusion-140030611.html; *id*. (Lightning cable provides 480 mbps transfer speed).

[132] Anne Schwedt, *EU-Kommission warnt Apple vor Einschränkungen bei Ladekabeln* [*EU Commission Warns Apple About Restrictions on Charging Cables*], DIE ZIET (May 4, 2023) (quoting a letter from European Commissioner Thierry Breton to Apple obtained by Deutsche Presse-Agentur), *available at* https://www.zeit.de/digital/mobil/2023-05/eu-kommission-apple-ladekabel-einschraenkungen-warnung.

[133] Council of the European Union Press Release 884/22, *supra* note 111.

[134] *See* Anthony Cuthbertson, *iPhone 15 Overheating Issue Makes It 'Too Hot to Touch,' Owners Say*, THE INDEPENDENT (Sep. 27, 2023), *available at* https://www.independent.co.uk/tech/iphone-15-overheating-charging-apple-b2419316.html.

[135] *See supra* notes 126-27 (20W for all iPhone 15 models); David Phelan, *Apple iPhone 15, iPhone 15 Pro Overheating Exclusive: Apple Comments*, FORBES (Oct. 3, 2023), https://www.forbes.com/sites/davidphelan/2023/10/03/apple-iphone-15-iphone-15-overheating-exclusive-apple-comments-iphone-15-overheating-solution-coming/.

[136] Patrick Holland, *A Fix Is Here: Apple Resolves iPhone 15 Pro Overheating Issues in Latest iOS 17 Update*, CNET (Oct. 7, 2023), https://www.cnbc.com/2023/10/04/apple-iphone-15-overheating-fix-released-in-ios-update.html; *Charging Cable Got So Hot It MELTED the Plastic, Broke Into My Phone and Burned My Finger. What Can I Do?*, Reddit (Dec. 24, 2023), https://www.reddit.com/r/iphone/comments/18pqsfj/charging_cable_got_so_hot_it_melted_the_plastic/.

[137] *See, e.g.*, Wash. Admin. Code 204-10-036(1).

[138] *See Davis v. Union Pac. R.R. Co.*, 2015 WL 12532124, at *1 (S.D. Tex. May 13,

high from the ground, it would be unstable.[139] By imposing minimum and maximum ground clearance requirements, regulators would achieve a balance between the risks of cars taking debris damage and toppling. It would be infeasible for firms to both comply with the design regulation *and* defeat the regulators' goal because the regulation is tailored to that goal—unless firms could circumvent the laws of physics. The same holds true for behavioral regulations. A federal law prohibiting form contracts from restricting bad consumer reviews[140] is narrowly tailored to achieve a well-defined objective.

The problem of complexity prohibitions is that they are not, and could not be, tailored to achieve a well-defined objective. For example, the ultimate goal of subscription bans is not really to ban the sale of *certain* features like heated seats by subscription. The goal is to ban the sale of *any* feature by any method which may make "[p]eople feel that they paid double" for any part of a car.[141] But no government could legislate the requirement "don't be too greedy," which forces legislators to specifically define features that cannot be sold by subscription and when that ban applies. Given the numerous ways in which firms can sell a certain feature by subscription while superficially staying compliant, the subscription ban could not be tailored to achieve the much broader purpose. This same problem causes right-to-repair laws to be easily defeated. The end goal of right-to-repair laws is to force products to be designed to enable repair for a "reasonable" price.[142] But the subjective nature of that word and the differences in products that affect the ease of repair thwart an objectively discernible, narrow definition of that goal. This results in the actual regulations having to be defined hyperspecifically despite the much broader nature of their goals, which results in easy circumvention.

Existing works that advocate for complexity prohibitions neglect how opaquely and broadly stated their purpose is, and hence how difficult they are to enforce. Professor Aaron Perzanowski argues that right-to-repair laws "simply require [product designers] to prioritize . . . familiar considerations" such as durability and repairability, "in order to meet clear objectives":

> Device makers would . . . resist any regulatory intervention in the design process. . . . [P]roduct design is a complex exercise that requires balancing and prioritizing a range of competing, interdependent considerations. Technical constraints limit

2015) (certain trucks required to have "a clearance of at least nine inches, in order to safely clear a railroad crossing") (citing TEX. TRANSP. CODE § 545.255(a)(2)(B)).

[139] *See Branham v. Ford Motor Co.*, 701 S.E.2d 5, 11 (S.C. 2010).

[140] 15 U.S.C. § 45b (Consumer Review Fairness Act).

[141] Charlton, *supra* note 22.

[142] *EU Right to Repair Law*, art. 5(2)(a).

> functionality; . . . consumer tastes and trends affect a range of product attributes; and legal rules . . . layer additional constraints across all these dimensions. No doubt, legal obligations . . . introduce additional complexity into the design process. But durability and reparability are hardly unknown considerations for designers. These rules simply require them to prioritize those familiar considerations in order to meet clear objectives.[143]

While the dictionary definition of repairability and durability is indeed plain, those ideas are not easily defined in the technical sense required for them to be legally enforceable. This is because, as discussed, "repairability" can only be legislated by banning specific features deemed to thwart repair—which can be easily defeated using other features the law neglected that thwart repair.

Some criticize firms that engage in legal circumvention as guilty of "malicious compliance," defined as "[c]omplying with the letter—but not the spirit—of the law."[144] But criticizing legal circumvention instead of the badly written laws that enable circumvention is like criticizing fire for killing people instead of the arsonist who started the fire. Take, for example, a business that prevents its workers from unionizing by deciding to go out of business. While preventing unionization is unethical, protesting outside the shuttered business will not make it reopen[145] because going out of business instead of accepting unionization is legal.[146] Persuading workers to unionize on more benign terms that enable the business to stay open would be more helpful, because having collective bargaining rights with a lower-than-expected raise is better than no union, no raise, and no job. Similarly, shaming legal circumvention is less likely to end it than designing a policy with fewer loopholes is. If the number of taxpayers who exploit tax code loopholes is any indication, even if legal circumvention were a sin, it would be a sin with too many offenders to punish.

C. The Cumulative Costs of (Circumventing) Complexity Prohibitions

Section I.B has shown how complexity prohibitions would exacerbate complexities that firms can exploit for profit, thus raising the cost of goods to consumers. Section I.C uses sequential games to model how that increase would occur over time. The model features two players, a firm and a regulator.

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[143] Perzanowski, *supra* note 21 at 389.

[144] *Malicious Compliance with Right to Repair Laws*, REPAIR.ORG (Jan. 26, 2024), https://www.repair.org/blog/2024/1/26/malicious-compliance-with-right-to-repair-laws.

[145] Anna Spiegel, *The Wydown Closes Popular D.C. Coffee Shops Amid Union Push*, AXIOS.COM (May 15, 2024), https://www.axios.com/local/washington-dc/2024/05/15/wydown-closes-dc-coffee-shop-union.

[146] *See Textile Workers Union of Am. v. Darlington Mfg. Co.*, 380 U.S. 263, 272 (1965).

The firm moves first and exploits a complexity for profit, thus increasing the price of its good by a fixed amount (say, by $100). The regulator follows and creates a complexity prohibition. This prohibition, while nullifying the firm's previous act, would not fully reverse the price increase caused by the firm because the firm would have incurred a cost to comply with the regulation, a cost the firm would pass onto consumers. For example, the prohibition might reduce the price of the good (which the firm increased by $100) by $98, the cost of compliance being $2. This process continues ad infinitum, with the firm finding a new complexity to exploit and the regulator nullifying it with a new complexity prohibition. As more prohibitions are enacted and defeated, the total cost of compliance, and thus the price of the good, would increase.

A pertinent question for this model is whether the marginal cost of compliance is constant or increasing. This question matters because, if the cost of implementing and circumventing each new prohibition increases over time, the total cost of compliance would rise exponentially. This is relevant to laws like the EU's right to repair law, which adds prohibitions as firms find more complexities to exploit for profit. There is good reason to think that the cost of circumventing each new complexity prohibition would increase over time, given an immutable and fundamental nature of any complex system: "everything is connected to everything else, whether directly or indirectly," due to the difficulty of "reduc[ing] a system to its constituent parts without killing it."[147] Oregon's ban on parts pairing intended to "[p]revent or inhibit" repair is an example.[148] Even though this law bans a specific feature, it would not make firms redesign their products so they are exactly the same as before, only without parts pairing. What may *seem* to be a change to one feature can in fact alter the entire product's design in significant and unanticipated ways:

> The effects of changes—even small, localized, isolated changes—are not always small, localized, or isolated. How many times have you heard a statement like, "How could that have happened? I only changed one line of code." A small change, even one line of code, can affect the behavior of the rest of the system. . . . A small change can trigger an inappropriate decision, leading the program down the wrong path. A small change can cause . . . bugs that exhibit their effects a long way from their origin. Side effects of changes can . . . break . . . interacting[] or underlying software.[149]

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[147] Liz Johnson, Complexity Modeling and Application to Policy Research, in HANDBOOK ON COMPLEXITY AND PUBLIC POLICY 150, 152 (Robert Geyer ed. 2015).

[148] OR LEGIS 69 (2024), 2024 Oregon Laws Ch. 69 § 1(2)(b) (S.B. 1596).

[149] REX BLACK, PRAGMATIC SOFTWARE TESTING: BECOMING AN EFFICIENT AND EFFICIENT TEST PROFESSIONAL 64 (2013).

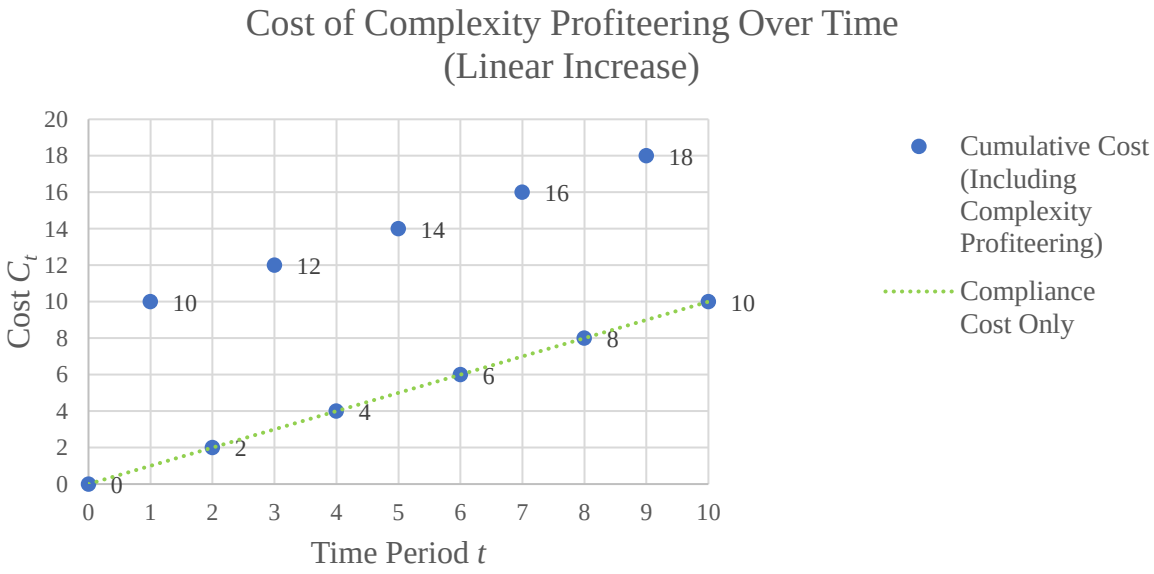
Applying this logic to complexity prohibitions, each additional ban and circumvention would become more costly because the effects of each ban would interact with the effects of the other bans, as Section I.B showed with examples of how complexity prohibitions can be circumvented over time. The rest of Section I.C presents two models, in which the cumulative cost of compliance respectively increases at a linear rate and at an exponential rate.

1. Constant Marginal Cost of Compliance

- Two players are involved: the firm and the regulator. The firm (Player 1) seeks to increase the global complexity and cost parameter *C*, which is also the price of the good. The regulator (Player 2) seeks to reduce the global complexity and cost parameter *C*.

- Each player moves in alternating turns. Player 1 moves first, followed by Player 2. In odd periods, Player 1 exploits a complexity that increases the cost parameter *C* by amount *x*. In even periods, Player 2 introduces a complexity prohibition that reduces the cost parameter by a positive fraction *r* of *x*, where $0 < r < 1$. *r* is the reduction factor.

- C_t is the global complexity and cost parameter at time period *t*.
    - $C_1 = C_0 + x$ (where C_0 is the cost parameter at period 0).
    - $C_2 = C_1 - r * x$ (reducing the increase from period 1).
    - Therefore, the formula generalizes to:
        - $C_{t+1} = C_t + x$ for odd *t* (Player 1's turn), and
        - $C_{t+1} = C_t - r * x$ for even *t* (Player 2's turn).
    - Where $C_0 = 0$, $r = 0.8$, $x = 10$, the cumulative cost and the cost of circumventing complexity prohibitions are as follows:

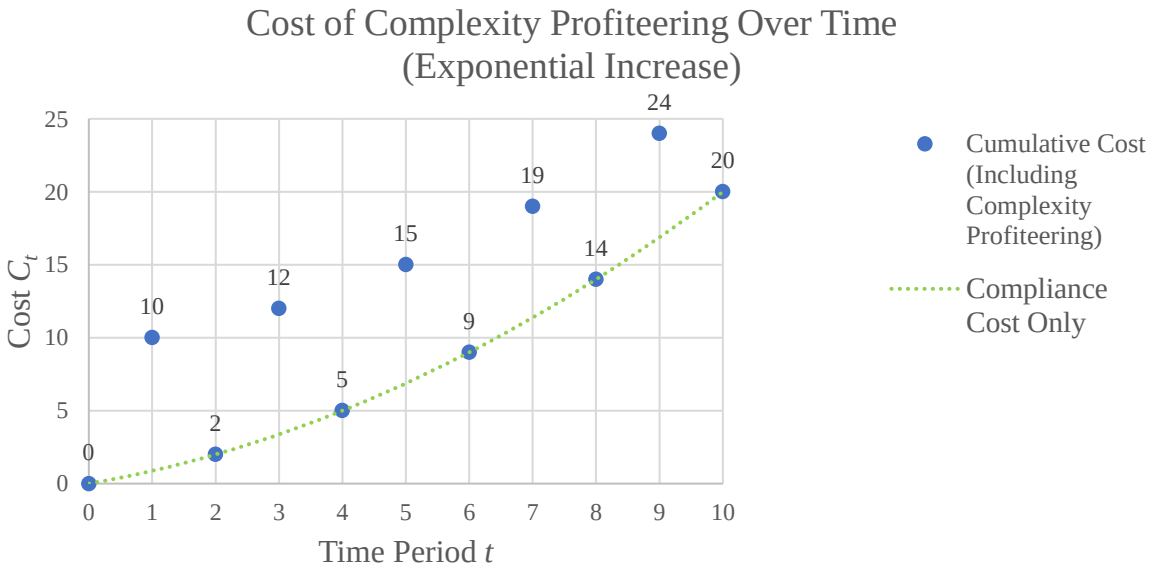


2. Increasing Marginal Cost of Compliance

- In this model, the marginal cost of compliance (circumvention) increases according to the number of complexity prohibitions implemented by the regulator. This is because, as explained, complexity prohibitions would interact with each other to complicate product design exponentially.
    - The number of complexity prohibitions implemented by the regulator is stated as $n_t = \left\lfloor \frac{t}{2} \right\rfloor$, where $\lfloor\ \rfloor$ is the floor function.

- The interaction term, according to which the marginal cost increases, is:
    - $i_t = \alpha * (n_t - 1)$
    - α is a constant representing the incremental cost due to interactions among the regulator's complexity prohibitions, and $(n_t - 1)$ ensures that the interaction term exists only when the regulator has implemented more than one complexity prohibition.

- The formula for C_t now becomes:
    - For all odd *t*, $C_t = C_{t-1} + x$, and
    - For even *t*,
        - If $n_t > 1,\ C_t = C_{t-1} - r * x + \alpha * (n_t - 1)$
        - Otherwise, $C_t = C_{t-1} - r * x$
    - Where $C_0 = 0,\ r = 0.8,\ \alpha = 1,\ x = 10$, the cost curve is:



There are two immediate implications of the rising compliance costs of complexity prohibitions. First, rising compliance costs harm consumers by raising prices. Second, rising compliance costs would harm small firms that are not as capable of absorbing such costs as their larger competitors are. A long line of research has found "strong evidence of higher [compliance] costs per dollar of revenue for small businesses," which held "across a wide range of types of requirements and types of firms."[150] If compliance costs are higher for smaller firms, rising compliance costs would serve as an entry barrier to smaller firms. Thus, complexity prohibitions would ironically give large firms even more market power by reducing competition, which would harm consumers in contravention of a central stated objective of complexity prohibitions: to "protect consumers from anticompetitive efforts [by firms] to limit repair"[151] and enable consumers to "shape their consumption . . . the way they want to and not the way they are forced to by manufacturers."[152]

Regardless of whether the cost of complexity prohibitions increases linearly or exponentially, this inquiry points to much broader implications for tech law. First, direct state regulation of specific design features does not necessarily increase state control over technology. Indeed, microregulations of technological design *reduce* state control by intensifying the phenomenon they seek to mitigate: complexity prohibitions worsen complexity profiteering by creating complex design features that firms can exploit. This finding is derivative of the much simpler, enduring truth that banning something does not necessarily end it. Technology develops specifically to skirt regulations, even when those regulations expressly forbid circumvention permit regulators to punish what they deem to be circumvention in their sole discretion.[153] In all, complexity prohibitions are indicative of a prevailing trend in modern tech law discourse: an increasing focus on direct control over market processes resulting in regulations that are hyperspecific to the point of infeasibility.

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[150] Paul Sommers & Roland J. Cole, *Costs of Compliance in Small and Medium-Sized Businesses*, 6 AM. J. SMALL BUSINESS 25, 26 (1981); *see also e.g.*, Jeyapalan Kaspillai, Mohamed Ariff & Mustafa Hanefah, *Compliance Costs of Small and Medium Enterprises*, 4 J. AUSTL. TAX'N 73, 73 (2002) ("[C]ompliance costs of [small and medium enterprises in Malaysia] are substantially higher compared with the costs measured for . . . larger firms.").

[151] *Governor Hochul Signs the Digital Fair Repair Act into Law* (Dec. 29, 2022) (press release from the office of the Governor of New York on right-to-repair law), *available at* https://www.governor.ny.gov/news/governor-hochul-signs-digital-fair-repair-act-law.

[152] European Commission Press Release IP/24/608, *Commission Welcomes Political Agreement on New Consumer Rights for Easy and Attractive Repairs* (Feb. 2, 2024) (quoting European Commission Vice-President Věra Jourová).

[153] Council Regulation 2022/1925 of Sept. 14, 2022, On Contestable and Fair Markets in the Digital Sector and Amending Directives (EU) 2019/1937 and (EU) 2020/1828 (Digital Markets Act), 2022 O.J. (L 265) 1 (Article 13, anti-circumvention); Kim, *supra* note 105, at 1292-96 (arguing that Article 13 would result in circumvention or harm to consumers).

II. A LAW DIVIDED: TECHNOCRACY AGAINST DEMOCRACY

Part I examined whether complexity prohibitions would achieve their stated objectives, without scrutinizing the normative assumptions underlying complexity prohibitions. Part II expands the inquiry to interrogate two such assumptions. First, how much do consumers want complexity prohibitions? Often, public approval is not necessarily the decisive factor in evaluating the soundness of public policy because most citizens lack expertise in regulatory minutiae.[154] But given that advocates cite public support as a core justification for complexity prohibitions,[155] examining the true extent of public support is warranted. Second, how would complexity prohibitions accurately identify instances of complexity profiteering? Part I assumed arguendo that practices which are widely considered to be complexity profiteering were indeed cases of complexity profiteering. But even the most well-credentialed experts have been wrong about the economic or societal consequences of new technology. For example, Nobel Prize-winning economist Paul Krugman predicted in 1998 that "[b]y 2005 or so, it will become clear that the Internet's impact on the economy has been no greater than the fax machine's"—ironically, in an article criticizing other economists for having mispredicted the consequences of new technology.[156] Given this possibility of error, laws that would prohibit specific technological or design features because of their future economic consequences must have mechanisms to minimize the likelihood of error and, when an error inevitably occurs, to minimize their harmful consequences.

Unfortunately, complexity prohibitions fail on both questions. On the first, the surveys cited by advocates as evidence of overwhelming support for complexity prohibitions are contradicted by consumers' *revealed* preferences in shopping habits, which calls into question whether complexity prohibitions are expressions of public or technocratic preferences. On the second, neither complexity prohibitions nor their advocates appear to account satisfactorily for the possibility of error. What if a feature that is widely suspected of being intended to thwart repair, for example, is actually valuable to consumers? If complexity prohibitions successfully ban the technology at issue, consumers would be permanently deprived of value-adding design features. If complexity prohibitions fail because firms circumvent them, consumers would end up paying more for that feature. Part II shows how, for these reasons, complexity prohibitions would be undemocratic and economically counterproductive.

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[154] *Cf.* Jennifer M. Kinsley, *Chill*, 48 LOY. U. CHI. L.J. 253, 256-57 (2016) ("The average reasonable person is likely unaware of the vast myriad of regulations on their speech.").

[155] *See supra* note 29 and accompanying text.

[156] Paul Krugman, *Why Most Economists' Predictions are Wrong*, RED HERRING (1998), https://web.archive.org/web/19980610100009/http://www.redherring.com/mag/issue55/economics.html.

A. Complexity Prohibitions Are Undemocratic

Advocates' substantial reliance on public support to justify complexity prohibitions may seem quaint at first sight. Policy recommendations in tech and consumer protection law are often based on the premise that the average person, for no fault of their own, lacks the knowledge needed to make rational decisions in those areas, and therefore that policy should temper the average person's instinct.[157] But when it comes to complexity prohibitions, advocates cite strong public support as an important reason to enact them. Perzanowski cites "more than 80% of respondents" supporting right to repair as evidence of firms "acting in ways that are inconsistent with demonstrated consumer expectations."[158] Consumer Reports, whose survey similarly found that 83% of respondents believe "repairability is very important" in consumer products, stated that a "majority of Americans expressed support for policies that would help ensure consumers [can] . . . repair their own products."[159] Nevertheless, scholars' inconsistent view of public opinion as something to be both wary of and relied upon does not mean that the public's preferences are worthless: "the fact that enough voters want [a law or regulation] is sufficient reason in a democratic society to seriously consider the proposal, at the very least."[160]

Indeed, the problem with citing public opinion to justify complexity prohibitions is not that public opinion is worthless. The problem is that the public may not actually want complexity prohibitions to the degree that their advocates believe. A long line of economics research has shown that *stated* preferences, such as survey responses, may not "measure the preferences they attempt to measure."[161] The extent of discrepancy between stated preferences and preferences revealed by actual behavior has been quantified as being up

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[157] *See, e.g.*, A. Michael Froomkin & P. Zak Colangelo, *Self-Defense Against Robots and Drones*, 48 CONN. L. REV. 1, 5 (2015) ("it will be difficult for the average person to know the capabilities of an unfamiliar robot . . . ."); Donna S. Harkness, *Packaged and Sold: Subjecting Elder Law Practice to Consumer Protection Laws*, 11 J.L. & POL'Y 525, 540 (2003) ("the law may seem extremely complex . . . to the average lay person."); Julia Alpert Gladstone, *Why Patenting Information Technology and Business Methods Is Not Sound Policy: Lessons from History and Prophecies for the Future*, 25 HAMLINE L. REV. 217, 228 (2002) ("The average person is still amazed and intrigued by the capabilities of computers.").

[158] Perzanowski, *supra* note 21 at 392.

[159] Mahoney & Slover, *supra* note 29.

[160] Yunsieg P. Kim, *A Revolution Without A Cause: The Digital Markets Act and Neo-Brandeisian Antitrust*, 2023 WIS. L. REV. 1247, 1258 (2023).

[161] Peter A. Diamond & Jerry A. Hausman, *Contingent Valuation: Is Some Number Better than No Number?* 8 J. ECON. PERSPECTIVES 45, 46 (1994); *see also* Simona Bigerna, Carlo Andrea Bollino, Silvia Micheli & Paolo Polinori, *Revealed and Stated Preferences for CO2 Emissions Reduction: The Missing Link*, 68 RENEWABLE & SUSTAINABLE ENERGY REV. 1213 (2017) (consumers state that they are willing to pay a carbon tax, but their actual behavior indicates that they must be compensated in order to accept a carbon tax).

to 41 percent.[162] In the case of complexity prohibitions such as right to repair, consumers' stated preferences appear to diverge significantly from revealed preferences. Studies show consistently that the average consumer replaces electronics like phones and computers well before the end of their lifespan for, among other reasons, "fashion."[163] One study found that "most products were replaced while they were still performing their main function" and 60 percent of those who replaced a product "did not even consider repairing it" before replacing it.[164] Given that a substantial number of consumers prioritize other considerations over product longevity and repairability in their actual purchasing behavior, survey responses that merely *state* majority support for complexity prohibitions are a questionable basis to determine the popular will.

My argument is not that *no* consumer prioritizes repairability. Some clearly do, while many others prioritize considerations other than repairability. This observation relies not on surveys, but on the variety of products on the market that cater to diverse preferences. For example, Lenovo has a history of releasing laptops whose covers are made of glass, such as the Yoga C930 Glass in 2018[165] and the Yoga Slim 9i in 2025.[166] Lenovo promoted the C930 as having a "[p]remium aluminum craftmanship and a unique glass cover,"[167] and the Slim 9i as having a "dazzling glass cover design with distinctive cat-eye jewelry texture."[168] At the 2024 Mobile World Congress, Lenovo debuted proof-of-concept designs it claims would "enhance user experiences in ways never imagined," indicating an intent to develop future products in alignment with such designs.[169] One such design was the "Transparent Display Laptop," presenting "a completely borderless and see-through display experience"[170]:

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[162] Kaat de Corte, John Cairns & Richard Grieve, *Stated Versus Revealed Preferences: An Approach to Reduce Bias*, 30 HEALTH ECON. 1095 (2021) (discrepancy between intended and actual frequency of blood donations is 41 percent for men and 30 percent for women).

[163] Wieser & Tröger, *supra* note 32.

[164] Lise Magnier & Ruth Mugge, *Replaced Too Soon? An Exploration of Western European Consumers' Replacement of Electronic Products*, 185 RESOURCES CONSERVATION & RECYCLING 106448 (2022).

[165] Mark Spoonauer, *Lenovo Yoga C930 Hands-On: Meet the New 2-in-1 King*, LAPTOPMAG (2018), https://www.laptopmag.com/articles/lenovo-yoga-c930-specs-price.

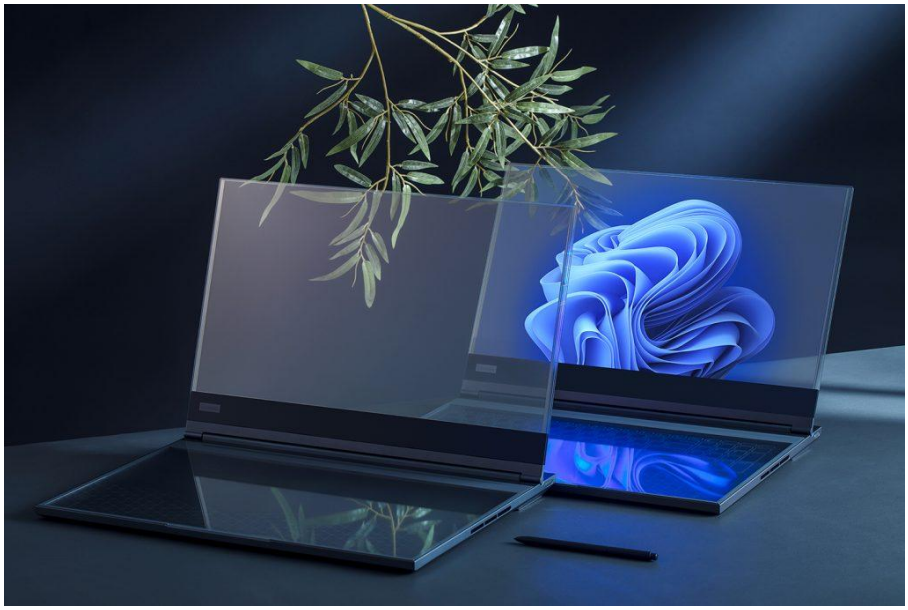
[166] Jorge A. Aguilar, *The Lenovo Yoga Book 9i Has 4K Dual Touch Screens*, HOW-TO GEEK (2025), https://www.howtogeek.com/lenovo-yoga-book-9i-4k-dual-touch-screen/.

[167] *Yoga C930 Glass*, LENOVO, https://www.lenovo.com/us/en/p/laptops/yoga/yoga-2-in-1-series/yoga-c930-13ikb-glass/88ygc900983.

[168] *Yoga Slim 9i*, LENOVO, https://www.lenovo.com/us/en/p/laptops/yoga/yoga-slim-series/yoga-slim-9i-gen-10-14-inch-intel/len101y0052.

[169] *Lenovo's Cutting-Edge ThinkPad and ThinkBook Laptops Pave the Way for AI PC Innovation at MWC*, Lenovo StoryHub, Feb. 25, 2024, *available at* https://news.lenovo.com/pressroom/press-releases/lenovos-cutting-edge-thinkpad-and-thinkbook-laptops-pave-the-way-for-ai-pc-innovation-at-mwc/.

[170] *Id*.



This design, which emphasizes aesthetics, comes at the cost of durability and repairability. For example, while some users have commented that the Yoga C930 Glass "looks beautiful and [they] want it," others have complained that "if dropped, [the glass] gets shattered completely" and "repairing the glass . . . once or twice would probably make up the price."[171] Indeed, official product documentation indicates that, were the glass to break, not only the glass but also the entire top case that houses the display would have to be replaced.[172]

On the other end of the design philosophy spectrum is the Framework laptop which, according to the manufacturer, is designed to be "easy to repair, last longer, and minimize environmental impact."[173] For example, "[e]very part is replaceable with just the one tool that comes in the box."[174] The laptop is modular so that replacing a battery, for instance, does not require replacing the speaker, keyboard, and the top case with it,[175] unlike the MacBook Pro.[176] However, this design philosophy comes at the cost of aesthetics. Compared

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[171] *Difference in price for no reason? Lenovo Yoga C930*, Tom's Hardware (Aug. 25, 2019) (consumer forum post), https://forums.tomshardware.com/threads/difference-in-price-for-no-reason-lenovo-yoga-c930.3517129/

[172] *Removal and Replacement Videos – Yoga C930-13IKB (81C4, 81EQ)*, LENOVO (upper case replacement), https://support.lenovo.com/us/en/solutions/ht509170-removal-and-replacement-videos-yoga-c930-13ikb-81c4-81eq.

[173] *Framework*, FRAMEWORK, https://frame.work/.

[174] *Framework Laptop 13 DIY Edition (Intel Core Ultra Series 1)*, FRAMEWORK, https://frame.work/products/laptop13-diy-intel-ultra-1/configuration/new.

[175] *Battery Replacement Guide*, FRAMEWORK, https://guides.frame.work/Guide/Battery+Replacement+Guide/85?lang=en.

[176] *See* APPLE, *supra* note 97.

to the sleek, glassy appearance of Lenovo's offerings, the Framework laptop looks bulkier and comes in only one color.[177] The firm states that "the chassis was designed to be easy to open and replace components" and is made of recycled aluminum without using dyes, so as to minimize industrial waste.[178]

The fact that the market offers both Framework and Lenovo laptops indicates genuine demand for both types of products: those which prioritize repairability at the expense of fashion, as well as those prioritizing fashion at the expense of repairability. There is no need to conduct surveys to ask how many people prioritize repairability and how many don't, because the market already meets those preferences. If consumers really do value repairability as much as right-to-repair advocates claim,[179] people can buy more Framework laptops and fewer laptops like the Yoga C930 Glass. But if a uniform right-to-repair law were to require *all* laptop computers to prioritize repairability and durability—as the EU's right-to-repair law would[180]—that would make all laptops look more like Framework laptops and less like Yoga laptops. This is because, as discussed, prioritizing repairability requires sacrificing other design priorities like fashion. Independent of whether people *should* value fashion in their purchases, complexity prohibitions like right-to-repair laws would prevent the market from serving the diverse consumer preferences that it is already serving in the status quo, by imposing the design preference of certain consumers (or the regulator) on all products and thus all consumers.

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[177] Framework, *Why the Framework Laptop 13 Only Comes in One Color*, YouTube (Sep. 26, 2023), https://www.youtube.com/watch?v=PURZRHu2TOg.

[178] *Id*.

[179] *See supra* note 29 and accompanying text.

[180] *See supra* Part I.B (discussing EU right to repair directive); *see also* Jared A. Mark, *Realizing A New Right: The Right to Repair at the Federal Stage*, 23 N.C. J. L. & TECH. 382, 412 (2021) (EU right to repair directive "observ[es] a right to repair in specific industries relating to home appliances. . . .").

The fact that complexity prohibitions like right to repair laws would be imposing the preferences of a few on the entire market makes them incoherent, because right-to-repair laws are presented as expressing the popular will. For illustration, consider Perzanowski's description of the Fairphone, a brand of smartphones prioritizing repairability and longevity over design aesthetics:

> The Fairphone, admittedly, doesn't sport the fastest processor, the brightest screen, or the sleekest design. But it is largely indistinguishable from other fully functioning smartphones of recent vintage. All designs entail compromise. A new Apple or Samsung phone might be a few millimeters thinner or load *Among Us* a fraction of a second faster. But the Fairphone's drawbacks are a reasonable sacrifice to make in the name of vastly improved longevity and far lower repair costs. It might be tempting to dismiss the Fairphone as . . . a proof of concept with no real viability in the marketplace. But Fairphone has sold hundreds of thousands of devices so far . . . .[181]

There is no doubt that Perzanowski sincerely believes that Fairphones are superior to the new iPhone or Galaxy. He may even be correct in the academic sense, in that "vastly improved longevity and far lower repair costs" do make the Fairphone a "reasonable sacrifice" for the majority of users, regardless of whether they agree. But the point is that many people disagree. If sales figures are an indication of public sentiment on repairability, as Perzanowski seems to believe, many more people disagree with him than agree. The Apple or Samsung phones whose sole virtue according to Perzanowski is that they are slightly thinner and load streaming shows marginally quicker have each sold in the billions,[182] while fewer than a million Fairphones have sold.[183] This means that, were the law to force all smartphones on the market to prioritize repair like the Fairphone, it would be imposing the preferences of a minority. As long as that is what a right-to-repair law does, advocates like Perzanowski cannot claim that such a law would merely enact the popular will.[184] This is especially so when the market is already democratic, in the sense that it caters to any consumer preference which is large enough to keep a firm profitable.

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[181] PERZANOWSKI, *supra* note 16 at 247.

[182] Sebastian Pier, *Samsung Sold Almost 3 Billion Phones Since 2014*, PHONEARENA (May 16, 2024), *available at* https://www.phonearena.com/news/samsung-sold-almost-3-billion-phones-since-2014_id158379.

[183] Sydney Boyo, *How the Apple iPhone Became One of the Best-Selling Products of All Time*, CNBC (Jan. 29, 2024), *available at* https://www.cnbc.com/2024/01/27/how-the-apple-iphone-changed-the-world.html.

[184] Perzanowski, *supra* note 21 at 392; *see also* Mark, *supra* note 180 at 413 (arguing that "many Americans yearn" for the kind of right to repair enshrined in EU law).

In sum, complexity prohibitions' claim to popular support is doubly contradicted. First, the claim itself—that a vast majority of the public supports them—is questionable, given the discrepancy between stated preferences for complexity prohibitions and preferences revealed by actual buying behavior. Second, the imposition of the preferences of a certain group of consumers and regulators makes complexity prohibitions more technocratic than democratic, particularly because the market upon which they would be imposed is already serving a diverse selection of consumer preferences. Indeed, the normative case for complexity prohibitions would be more internally coherent if their claim to popular support was dropped. Advocates of complexity prohibitions could argue that consumers are wrong to buy as many unrepairable goods as they do, given the unsustainable amount of waste that such a habit undeniably generates,[185] and thus that they should be forced to prioritize repairability for their own good. Such an argument would not be unprecedented. At least since Edmund Burke in the 18th century, the "trustee" model of representation has argued that "[y]our representative owes you, not his industry only, but his judgment; and he betrays, instead of serving you, if he sacrifices it to your opinion."[186] More recently, academics have defended regulatory paternalism with the claim that few people know what is best for themselves.[187] Although such a defense of complexity prohibitions could be criticized as undemocratic, it at least could not be criticized for being both undemocratic *and* incoherent.

B. Complexity Prohibitions Do Not Account for Error

> "[The iPhone] isn't really revolutionary . . . [and] will not turn any industry inside out."
>
> – Professor Tim Wu, Columbia Law School[188] [189]

As a punishment becomes harsher, the harms of mistakenly punishing an innocent conduct or party grow correspondingly. One oft-cited reason for opposing the death penalty, for instance, is that it is irreversible.[190] Hence,

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[185] *See, e.g.*, Beth Ann Fiedler, International Changes in Environmental Conditions and Their Personal Health Consequences, *in* TRANSLATING NATIONAL POLICY TO IMPROVE ENVIRONMENTAL CONDITIONS IMPACTING PUBLIC HEALTH THROUGH COMMUNITY PLANNING 255, 262 (Beth Ann Fiedler ed. 2018) ("Nothing brings the problem of overconsumption in developed nations to the fore like the global problem of e-waste.").

[186] EDMUND BURKE, SELECTED WRITINGS AND SPEECHES 224 (Peter J. Stanlis ed. 2009).

[187] *See* Jonathan Klick & Gregory Mitchell, *Government Regulation of Irrationality: Moral and Cognitive Hazards*, 90 MINN. L. REV. 1620, 1620–21 (2006).

[188] Tim Wu, *iPhony*, SLATE (June 29, 2007), https://slate.com/technology/2007/06/why-the-iphone-isn-t-really-revolutionary.html.

[189] Tim Wu, Columbia Law School, https://www.law.columbia.edu/faculty/timothy-wu.

[190] *See, e.g.*, Lewis F. Powell, Jr., *Capital Punishment*, 102 HARV. L. REV. 1035, 1041 (1989) ("[I]t bears repeating that death is a unique punishment in that it is irreversible.").

laws that would mete out serious punishment must present a way to minimize the likelihood and impact of error. Separate from their efficacy in practice, "death penalty cases offer far more opportunities and incentives for reversal than other criminal trials" to at least try to reduce the likelihood of error.[191] Beyond the lone example of capital punishment, "it is a cardinal principle of Anglo-American jurisprudence that . . . better ten guilty persons should go free than one innocent person be convicted."[192] Although not on the level of capital punishment, complexity prohibitions represent a serious and hard-to-reverse punishment in that they would ban the use of a technology or design feature as long as the relevant laws and regulations remain on the books. Because the consequence of banning certain technologies may be that the technologies in question can no longer be refined, developed, and put to good use in the future, complexity prohibitions must minimize the likelihood and impact of error—a concrete possibility, given that even some of the most renowned experts have misjudged the potential and consequences of new technology.[193]

Complexity prohibitions, in their current form, do not account for the possibility of error. What complexity prohibitions do is not to adjudicate if a technology or design feature presents an excessive risk of profiteering. What they do is to assume that a technology or design feature is being (or will be) used to profiteer, and to permanently ban it. For example, a law banning parts pairing for smartphones[194] requires the belief that such a design would harm users. Were there any doubt, a permanent ban would not have been enacted. This is true of other complexity prohibitions such as the proposed ban on the sale of heated seats by subscription;[195] this ban would not have been proposed if there was any doubt that this sales scheme is intended to profiteer at the expense of consumers. Indeed, the most vocal commentators on BMW's ill-fated attempt to sell heated seats for a monthly fee indicated no doubt that it was intended to get consumers to pay "indefinitely into the future" for cars they already bought[196] and that BMW's attempt represented a "dystopia."[197]

Although this perception may well be correct, it may also be incorrect, meaning that a law based on such a perception could end up banning a feature that adds value for consumers. First, selling optional features by subscription

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[191] Barry Latzer & James N.G. Cauthen, *Capital Appeals Revisited*, 84 JUDICATURE 64, 70 (2000) (offering an explanation for "the high conviction reversal rate" in capital cases).

[192] *United States v. Greer*, 538 F.2d 437, 441 (D.C. Cir. 1976) (citing Blackstone).

[193] *See, e.g.*, Krugman, *supra* note 156 (the internet); Wu, *supra* note 188 (the iPhone).

[194] *See* OR LEGIS 69 (2024), 2024 Oregon Laws Ch. 69 § 1(1)(d)(B) (S.B. 1596).

[195] *See supra* notes 52-54 and accompanying text.

[196] Rossmann, *supra* note 35.

[197] Matt Posky, *Driving Dystopia: BMW Sneaks Subscription Services Back Into Vehicles*, THETRUTHABOUTCARS (July 23, 2024), https://www.thetruthaboutcars.com/cars/news-blog/driving-dystopia-bmw-sneaks-subscription-services-back-into-vehicles-44508289.

could save consumers money. Recall that BMW's model would involve selling everyone the same car and enabling heated seats only for those who pay the monthly fee.[198] This means that BMW would need to manufacture only one trim for a given car as opposed to multiple trims that come with and without heated seats, such as the 2024 Chevy Tahoe.[199] Having to produce only one trim would make production "far cheaper," a strategy that other carmakers appear to have adopted.[200] BMW has an incentive to pass these cost savings on to consumers so that more would consider buying BMW cars instead of more expensive cars marketed by its competitors. Indeed, BMW's subscription model would have offered a "lower upfront price for the car" and further potential cost savings by enabling consumers to "only pay for [a] feature [such as heated seats] when it might be needed, like in the winter."[201]

Second, the subscription model could have offered consumers more flexibility. A survey by the loan facilitator LendingTree found that "nearly 40% of consumers who[] purchased a vehicle" regretted it later, a reason being the "unaffordably expensive" price.[202] Having to buy optional features up front would add to the price and thus the risk of regret. BMW's sales model "was intended to be one of many ways to offer flexibility to customers, who could opt in to pay for vehicle functions when it suited them, then stop paying when they were no longer wanted."[203] This strategy of offering more flexibility is consistent with other developments in BMW cars, like the "E Ink technology" that would enable consumers to "change [a BMW's] colors on command."[204] To be sure, it is possible that BMW's true intent is not to deliver value to consumers, but to "nickel-and-dime" them.[205] At the very least, the fact that

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[198] Valdes-Dapena, *supra* note 1.

[199] *Which Chevy Tahoe Trim Level Is Right for You?*, SCHUMACHER CHEVROLET CLIFTON (trims with and without heated seats), https://www.schumacherchevroletclifton.com/new-chevy/compare-trims-chevy-tahoe-suv.htm.

[200] Chris Bouchard, *The Pros and Cons of a Single-Trim Vehicle Strategy*, DATAONE SOFTWARE (Nov. 17, 2015), https://vin.dataonesoftware.com/vin_basics_blog/single-trim-vehicle-strategy-pros-and-cons.

[201] Valdes-Dapena, *supra* note 1; Cenizo, *supra* note 36 (showing that consumers would save money from the heated seats subscription if they subscribed "for the three coldest months of the year" and did not drive the same car for "nearly a decade.").

[202] Jenn Jones, *Nearly Half Who Bought a Car in the Past Year Have Regrets*, LENDINGTREE (Jan. 24, 2022), https://www.lendingtree.com/auto/car-regrets-survey/.

[203] Charlton, *supra* note 22.

[204] Patrick George, *Check Out BMW's Color-Changing Concept Car in Action*, THE VERGE (Jan. 5, 2023), https://www.theverge.com/2023/1/5/23540358/bmw-color-changing-car-concept-e-ink-i-vision-dee-ces.

[205] Josh Max, *Your New Car Isn't Yours – Automakers Increasingly Charge "Subscription Fees"*, FORBES (Jan. 2, 2025), https://www.forbes.com/sites/joshmax/2025/01/02/your-new-car-isnt-yoursautomakers-increasingly-charge-subscription-fees/.

consumers did not believe BMW's claim is the fault of none but BMW—as is made clear by the saying "the customer is always right." The point is that BMW's subscription model *could* have added value for consumers, and thus that the complexity prohibitions that would ban that model could be mistaken.

Of course, the market can be mistaken, just as complexity prohibitions can be. Indeed, when one is mistaken, the other is also likely to be mistaken. Assume for the sake of argument that BMW's subscription model would actually have been value-adding. Recall that negative market reaction forced BMW to abandon that model,[206] which likely incentivized state legislatures to consider prohibiting the sale of heated seats by subscription,[207] given that politicians respond to voters and elections have consequences.[208] My claim is not that markets are always efficient or that regulation is always misguided.

Rather, my argument is that, if errors are inevitable, it is preferable to have a mistaken market than mistaken laws. This is because the errors of the market in this context are far easier to correct than the errors of complexity prohibitions. When a law erroneously prohibits a value-adding technology, it would be permanent as long as the law stays on the books. Although such an error could be corrected by repealing the law, "it can be slow and difficult to repeal laws through the legislative process" in the United States due to "constitutional requirements of bicameralism and presentment" in addition to "numerous [legislatively] created 'veto gates.'"[209] Examples of laws forcing the use of outdated technology also abound outside the U.S. The Japanese government declared only in June 2024 that it "won the war on floppy disks" by "scrapp[ing] all 1,034 regulations governing their use," while continuing to use fax machines.[210] In contrast, when consumers mistakenly boycott a good product, they can buy it again if a firm offers it again in the future.[211]

In short, combating predatory design practices does not require the law to ban designs that particular people deem to be predatory; consumers need only reject such practices themselves. Part III discusses what the state could do to aid consumers in exercising the power to vote with their wallets.

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[206] *See* Charlton, *supra* note 22 ("People feel that they paid double" for heated seats).

[207] *See supra* notes 51-52 and accompanying text.

[208] *See* ANTHONY DOWNS, AN ECONOMIC THEORY OF DEMOCRACY 43 (1957) ("[Voters] often compare what government is doing with what it should be doing without referring to any other party."); *id*. at 128 ("No party . . . can survive without . . . the support of a sizeable fraction of the electorate—a support active enough to be expressed by votes in elections.").

[209] Michael Sant' Ambrogio, *The Extra-Legislative Veto*, 102 GEO. L.J. 351, 354 (2014).

[210] Scharon Harding, *Japan Wins 2-Year "War on Floppy Disks," Kills Regulations Requiring Old Tech*, ARS TECHNICA (July 3, 2024), https://arstechnica.com/gadgets/2024/07/japans-government-finally-exits-90s-ends-floppy-disk-use/.

[211] *Cf*. Cenizo, *supra* note 36 (BMW planning to offer subscriptions again in the future).

III. A BETTER WAY: HELPING PEOPLE VOTE WITH THEIR WALLETS

The inefficacy and high cost of complexity prohibitions discussed thus far prompt a question: is there a more effective and less costly solution to complexity profiteering? With exceptions, such as when a firm has no real competitor, a more effective and cheaper solution is to inform consumers about firms engaging in complexity profiteering so that people can vote with their wallets. When I say that informing consumers would be more effective, I am not claiming that this solution is *guaranteed* to work. Rather, the claim is that complexity prohibitions would fail, whereas informed consumers have successfully punished firms appearing to engage in complexity profiteering. A firm engages in complexity profiteering when it believes that people will continue to buy from it, despite it taking profits without adding value. As long as it has customers, a typical firm will circumvent any complexity prohibition meant to control its behavior, which is why it fails as shown in Part I. In contrast, consumers voting with their wallets against complexity profiteering undermines firms' incentive to continue in it. Among many other examples, consumers rejecting monthly fees for heated seats has forced firms to desist.[212]

In addition to being more effective than complexity prohibitions, helping people vote with their wallets would also be cheaper. The cost of informing consumers is the cost of devising a method that overcomes our natural reluctance to look up new information and, when we do so, does not drown us in irrelevant information.[213] But helping people vote with their wallets incurs no other costs because it uses natural incentives for the rest of the work. Complexity prohibitions would control firm behavior by trying to force firms to act *against* their incentives, by designing products to be less profitable. In contrast, people dissatisfied by firms engaging in complexity profiteering would control firm behavior by acting *on* their incentive to get the best value for money. As more people vote with their wallets, firms would act on their natural incentive to avoid their customers' ire and to redirect that ire to competitors, by advertising that they eschew complexity profiteering. Such advertising would defray some of the state's cost of informing people on which firms engage in complexity profiteering. This scheme would also avoid the risk of complexity prohibitions based on the state's misperceptions of market preferences. My proposed solution to inform consumers, the Buyer Beware Platform (BBP), is a variation of a website that the EU would use to inform consumers about repair, which is required by its right to repair law.

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[212] Charlton, *supra* note 22.

[213] *See* GLORIA R. BURTHOLD, PSYCHOLOGY OF DECISION MAKING IN LEGAL, HEALTH CARE, AND SCIENCE SETTINGS 33 (2007) (people use cognitive shortcuts called heuristics "when overloaded with information . . . or when we have little or no information.").

A. Informing Consumers Is More Effective than Complexity Prohibitions

> "Apple repeatedly chooses to make its products worse for consumers to prevent competition from emerging."[214]
>
> – U.S. Department of Justice

Perhaps the best way to illustrate why helping people vote with their wallets is more effective than complexity prohibitions is to discuss their underlying assumptions and justifications. Complexity profiteering is firms complicating their products to extract profit without adding value which, from the consumer's perspective, is synonymous with making the products worse. Once people become aware that a firm is reducing value for the money they spend, they can credibly threaten to take their business to a competitor—for example, by threatening to buy a car that does not require monthly fees for heated seats.[215] If a firm refuses to surrender to such threats, consumers can carry them out. For example, consumers could buy phones that do not require any tools to replace batteries[216] and do not display certain text messages in a different color.[217] The share of iPhones among newly activated phones in the U.S. in the first quarter of 2024 was 33 percent, the lowest since 2018.[218]

Complexity prohibitions assume that firms remove their customers' power to vote with their wallets. For example, the U.S. antitrust complaint filed against Apple in March 2024 claims that "Apple drives iPhone users away from products and services that compete with or threaten Apple" and, by doing so, "increases the cost . . . of switching from the iPhone to another smartphone."[219] Consumers' alleged inability to choose the goods they want justifies the state forcing firms to redesign products in the way that the state thinks people want. The U.S. antitrust case against Apple seeks to ban core features of many of its products, such as the iPhone and Apple Watch.[220] The EU has forced iPhones to change their charging cable design to USB-C.[221]

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[214] *Apple Antitrust Complaint*, at ¶ 10.

[215] *See* Charlton, *supra* note 22.

[216] *See supra* note 9 (Samsung Android phone requiring no tools for battery replacement).

[217] Boone Ashworth, *Android Users Can Now 'Like' Messages from iPhones*, WIRED (Oct. 22, 2022) (Android phones show Android messages and iMessages in the same color), https://www.wired.com/story/android-users-can-like-iphone-messages-now/; *Apple Antitrust Complaint* at ¶ 90 (iPhones show Android texts in green and iMessage in blue).

[218] Koetsier, *supra* note 23; *Apple Loses Top Phonemaker Spot to Samsung as iPhone Shipments Drop, IDC Says*, REUTERS (April 15, 2024) https://www.reuters.com/technology/apple-loses-top-phonemaker-spot-samsung-iphone-shipments-drop-idc-says-2024-04-15/.

[219] *Apple Antitrust Complaint*, ¶ 55.

[220] *Id.* at ¶ 232 (requested relief including "preventing Apple from using [its] APIs to undermine cross-platform technologies like messaging, smartwatches . . . among others").

[221] *EU Common Charging Directive*, art. 2(1).

This assumption that consumers cannot vote with their wallets is often unfounded. How does a manufacturer "repeatedly choos[ing] to make its products worse for consumers" somehow "prevent competition from emerging"?[222] The correct answer is that it does not. A firm making its own products worse only *strengthens* consumers' incentives to abandon that firm. What the U.S. describes as Apple entrenching its "smartphone monopoly"[223] is in fact complexity profiteering—Apple complicating its products to extract profits without adding value, at the risk of disgruntled consumers leaving Apple. The appropriate solution to Apple's complexity profiteering is to inform consumers so that more of them can vote with their wallets, which is demonstrably possible given that "Apple is capturing only 33% of new [U.S. smartphone] sales" in the first quarter of 2024.[224] But, instead of leveraging this existing market force, the U.S. and other similarly minded regulators would micromanage how Apple designs its products because they erroneously believe that consumers cannot vote with their wallets.[225] As Part I showed, complexity prohibitions would be infeasible because firms would exploit their superior knowledge of their own products and practices to circumvent them.

The examples cited by the U.S. in support of its case show that it has misperceived complexity profiteering as Apple entrenching its purported monopoly. An example is the U.S.'s claim that Apple "blocked cloud gaming apps that would have given users access to desirable apps and content without needing to pay for expensive Apple hardware because it would threaten its monopoly power."[226] Without cloud apps, users must install whatever game they want to play on their own devices.[227] Sophisticated programs, including many smartphone games, require expensive hardware with large data storage and high computing power.[228] Cloud service providers use their own servers to store this large amount of data and do the sophisticated computing so that smartphone users need only connect to company servers over the internet.[229] By using these servers, cloud apps enable the use of sophisticated programs with relatively cheap hardware, regardless of brand.[230] "For years," Apple required developers to distribute any game "as a stand-alone app" for the iPhone, so that iPhone users would be forced to "download cloud streaming software separately for each individual game" instead of downloading just

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[222] *Apple Antitrust Complaint*, ¶ 10.
[223] *Id*.
[224] *See* Koetsier, *supra* note 23.
[225] *See supra* 219-21 and accompanying text; Part I.
[226] *Apple Antitrust Complaint*, ¶ 71.
[227] *Id*. at ¶ 72.
[228] *Id*. at ¶ 73.
[229] *Id*. at ¶ 72.
[230] *Id*. at ¶ 72-73.

one cloud app to play many games.[231] This is comparable to blocking Netflix so as to make users download an app for each show they want to watch. The U.S. argued that this requirement, "[u]ntil recently . . . made cloud . . . apps so unattractive to users that no developer designed one for the iPhone."[232]

The U.S.'s claim that Apple "blocked cloud . . . apps" and made users "download cloud streaming software separately for each individual game" because not doing so "would threaten its monopoly power"[233] is illogical. Making a popular service unavailable on iPhones makes users *more* likely to switch to non-Apple phones, not less. If denying cloud gaming made iPhone users "more beholden to" Apple,[234] Apple would never let anyone provide cloud gaming on iOS. But Apple *has* allowed a competitor (Microsoft, no less) to provide "hundreds of games" via cloud streaming using one software on iOS since 2021[235] and permitted the distribution of cloud apps via the App Store since January 2024[236]—facts the U.S. seems to acknowledge only by stating that Apple blocked cloud gaming "[u]ntil recently."[237] Apple forcing developers to distribute games individually through its App Store is an act of complexity profiteering because Apple collects a fee for the first one million installs of an app per year, a fee that would increase if more apps are required for the same service.[238] Apple letting Microsoft—one of its most formidable competitors[239]—provide cloud games on the iOS is Apple relenting to users voting with their wallets, after years of complaints that "Apple's excuse for denying Xbox Cloud is patently absurd."[240] Contrary to the U.S.'s claim, the solution to Apple denying cloud gaming is not to micromanage how Apple designs its various products,[241] but to help consumers vote with their wallets.

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[231] *Id*. at ¶ 76-77.

[232] *Id*. at ¶ 77.

[233] *Id*. at ¶ 71, 77.

[234] *Id*. at ¶ 185.

[235] Chance Miller, *Xbox Cloud Gaming Launches for iPhone and iPad in Safari with Over 100 Titles*, 9TO5MAC (June 28, 2021) (Xbox cloud gaming via the Safari browser), https://9to5mac.com/2021/06/28/xbox-cloud-gaming-safari-iphone-ipad-app/.

[236] *Apple Introduces New Options Worldwide for Streaming Game Services and Apps That Provide Access to Mini Apps and Games*, APPLE ("Developers can now submit [one] app" for "all . . . games in their catalog"), https://developer.apple.com/news/?id=f1v8pyay.

[237] *Apple Antitrust Complaint*, ¶ 77.

[238] *See Commissions, Fees, and Taxes*, APPLE, https://developer.apple.com/help/app-store-connect/distributing-apps-in-the-european-union/commissions-fees-and-taxes/.

[239] Aditya Soni, *Microsoft Briefly Overtakes Apple as World's Most Valuable Company*, REUTERS (Jan. 11, 2024), https://www.reuters.com/technology/microsoft-overtakes-apple-worlds-most-valuable-company-2024-01-11/.

[240] Jason Cross, *Apple's Excuse for Denying Xbox Cloud Gaming is Patently Absurd*, MACWORLD (Aug. 20, 2020), https://www.macworld.com/article/234477/apples-excuse-for-denying-xbox-cloud-gaming-is-patently-absurd.html.

[241] *Apple Antitrust Complaint*, at ¶ 232 ("preventing Apple from using [its] APIs").

The U.S. also cites messaging on the iPhone as another example of Apple's attempt to "build and maintain its monopoly power."[242] The U.S. cites Apple making "third-party messaging apps on the iPhone" and messages from Android phones "worse . . . relative to . . . Apple's own messaging app," iMessage.[243] The U.S. focuses particularly on how messages from Android phones are displayed on iMessage. iMessage applied the old SMS protocol to messages from Android[244] and a more advanced protocol to messages from other iPhones.[245] Therefore, when iPhones receive messages from Android phones, "the text appears . . . as a green bubble" instead of the iMessage's default blue,[246] "the conversation is not encrypted, videos are pixelated and grainy, and users cannot edit messages or see typing indicators."[247] This, the U.S. argues, "signals to users that rival smartphones are lower quality" and gives non-iPhone users "social stigma, exclusion, and blame for 'breaking' chats where other participants own iPhones."[248] In an apparent attempt to show how such tactics "make[] it more difficult to switch smartphones,"[249] the U.S. cites an event where a user asked Apple CEO Tim Cook "whether Apple would fix iPhone-to-Android messaging," stating that "I can't send my mom certain videos," to which Cook replied, "[b]uy your mom an iPhone."[250]

Messaging on iPhones is another example of complexity profiteering which the U.S. misperceives as Apple attempting to entrench its purported smartphone monopoly. If degrading the messaging experience for Android phones and third-party apps really helped strengthen a monopoly, Apple would never improve it. Yet, the U.S. contradicts its own argument by saying that, if Apple improved the messaging experience for non-Apple apps and phones, "the iPhone would be more valuable"[251]—indicating that degrading the experience *strengthens* users' incentive to abandon the iPhone. Indeed, a year after Cook apparently told an Android user that the only way to improve the messaging experience with an iPhone user was to switch to an iPhone,[252] Apple decided to improve Android users' messaging experience with iPhone users. In 2023, Apple announced that iPhones would begin to apply the Rich

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[242] *Id*. at ¶ 80.
[243] *Id*. at ¶ 85.
[244] *See* Aditya Soni, *Group Chats Between Android and iOS Might Be Getting Better — But Only for iPhones*, THE VERGE (June 7, 2023), https://www.theverge.com/2023/6/7/23752744/android-ios-17-group-chat-imessage-edit-green-bubble.
[245] *Apple Antitrust Complaint*, at ¶ 85.
[246] *Id*. at ¶ 90.
[247] *Id*.
[248] *Id*. at ¶ 91.
[249] *Id*.
[250] *Id*. at ¶ 92.
[251] *Id*. at ¶ 87.
[252] *Id*. at ¶ 92.

Communication Services (RCS) protocol instead of the old SMS protocol to messages from Android smartphones.[253] The RCS protocol would give Android users messaging iPhones "typing indicators, high-resolution media sharing[,] and end-to-end encryption"[254]—three of five traits of Android-to-iPhone messaging that the U.S. argued were intended to *prevent* iPhone users from switching to Android.[255] In particular, the RCS protocol would enable Android users to send iPhones high-resolution videos, the precise problem which Cook previously said could only be fixed by switching to an iPhone.

The U.S. acknowledges Apple's adoption of RCS, but not the fact that it would address three of the five defects of Android-to-iPhone messaging it cited as evidence of Apple's purported smartphone monopoly. The U.S. also attempts to play down the effect of Apple's adoption of RCS by using a hypothetical which, contrary to the U.S.'s intent, illustrates the *superiority* of consumers voting with their wallets compared to complexity prohibitions. The U.S. argues: "the RCS standard will continue to improve over time, and if Apple does not support later versions of RCS, cross-platform messaging using RCS could soon be broken on iPhones anyway."[256] Set aside the fact that the U.S. is citing something that has not happened to support the claim that Apple has already committed an antitrust violation.[257] Apple defeating RCS by intentionally failing to update it is what would likely happen if RCS was imposed using complexity prohibitions. After all, that is what Apple did in response to a complexity prohibition forcing iPhones to use USB-C: Apple changed the *shape* of the iPhone 15's charging socket to USB-C, while still using the slow USB 2 protocol from 2000.[258] In contrast, if Apple's adoption of RCS resulted from consumers voting with their wallets by threatening to abandon Apple, it would have an ongoing incentive to keep RCS up to date. Indeed, there is good reason to think that market pressure, not the Department of Justice, is responsible for forcing Apple to improve iMessage. Despite the U.S.'s argument that iMessage "helps build and maintain [Apple's] monopoly,"[259] iMessage is only the third most popular messenger platform in the U.S. as of March 2024 behind Facebook Message and Instagram, and

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[253] Chance Miller, *Apple Announces that RCS Support Is Coming to iPhone Next Year*, 9TO5MAC (Nov. 16, 2023), https://9to5mac.com/2023/11/16/apple-rcs-coming-to-iphone/.

[254] Abrar Al-Heeti, *RCS on iPhones Will Make Texting Android Users Less Tedious*, CNET (April 30, 2024), https://www.cnet.com/tech/mobile/rcs-on-iphones-will-make-texting-android-users-less-tedious/.

[255] *Apple Antitrust Complaint*, at ¶ 90.

[256] *Id*. at ¶ 89.

[257] *Cf*. Kim, *supra* note 111, at 1303-05 (criticizing the EU Digital Markets Act for "punishing conduct that is not anticompetitive in the present for the reason that it *might* become anticompetitive in the future.").

[258] *See supra* Section I.B.

[259] *Apple Antitrust Complaint*, at ¶ 80.

only marginally ahead of WhatsApp,[260] all of which are owned by Meta.[261]

B. A Cheaper and Better Solution: The Buyer Beware Platform

In addition to being more effective, helping consumers vote with their wallets would also be cheaper than complexity prohibitions. To be sure, informing people about complex consumer goods would not be cheap in an *absolute* sense. One need not even refer to high-tech products to appreciate the challenges of informing people, even on things that they have an interest in knowing. "[P]eople too often sign documents without reading them,"[262] even documents that are (at least superficially) intended to inform them. For example, the terms of service for a gym may allow anyone to join online[263] but permit cancellations only by in-person visits or certified mail, resulting in unpleasant surprises to consumers trying to cancel by phone or email.[264] If people do not read binding documents before signing their own names, informing people about the many things they buy might be highly difficult.

But the cost of a policy must be compared to its anticipated benefits, as well as the costs and benefits of alternatives. As Part I showed, complexity prohibitions can incur ever-increasing costs without commensurate benefits because firms have a permanent incentive to circumvent as long as people continue to buy from them. In contrast, the benefit of informing consumers is cutting off the demand that fuels this circumvention. The benefit of such demand-side policies is recognized by none other than the EU's right to repair law which, ironically, focuses primarily on supply-side regulations such as complexity prohibitions.[265] The law "lays down demand-side requirements ensuring the provision of better information on durability and repairability of goods" so that consumers can "easily compare repair services."[266] If, as the EU assumes, it is worth telling people where, when, and how to repair their products, then it is certainly worth telling people about which products are overengineered to extract profits by thwarting repair, so that consumers do not buy those products and do not have to learn how to repair them. If a

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[260] STATISTA, *Penetration of Leading Messenger Platforms in the United States as of March 2024*, https://www.statista.com/statistics/294439/messenger-app-share-us-users/.

[261] See META, *Our Technologies*, https://about.meta.com/technologies/.

[262] Klint L. Bruno & Michael L. Closen, *Notaries Public and Document Signer Comprehension: A Dangerous Mirage in the Desert of Notarial Law and Practice*, 44 S.D. L. REV. 494, 534 (1999).

[263] *Join Us*, PLANET FITNESS, https://www.planetfitness.com/gyms/.

[264] *See* Caroline Praderio, *A Man Couldn't Cancel His Gym Membership Over the Phone — So He Wrote an Epic Breakup Letter Instead*, BUSINESS INSIDER (Feb. 1, 2018), https://www.businessinsider.com/man-writes-breakup-letter-to-planet-fitness-2018-2.

[265] *See supra* notes 92-96 and accompanying text.

[266] *EU Right to Repair Law*, Recital 5, 10.

consumer decides not to buy an iPhone because the consumer learns that its battery cannot feasibly be replaced at costs that justify the procedure,[267] the state would not have to teach that consumer how to replace iPhone batteries.

My proposal to inform consumers about complexity profiteering, a website I call the Buyer Beware Platform (BBP), is modeled off the EU's forthcoming website to inform consumers about the right to repair called the "European Online Platform for Repair" (OPR), which would be developed and operated by the European Commission and member states.[268] The BBP, like the OPR, would be run by the state because informing consumers about complexity profiteering is a type of public good, at least initially.[269] When consumers are not sufficiently aware of complexity profiteering, private firms that stand to profit from that practice would lack the incentive to call attention to it, leaving the task to the government. Once consumers become aware of complexity profiteering, firms would benefit from advertising the lack of complexity profiteering in their products, similar to how the public becoming aware of the harms of sugar incentivizes firms to advertise sugar-free soft drinks.[270] Initially, however, the government would inform consumers about complexity profiteering—just as the state has raised awareness of the harms of sugar through mandatory nutrition labels and information campaigns.[271]

Having established that the BBP would be state-run, the next issue is how to advertise it and make it painless to access. While marketing the BBP may seem to be beyond regulators' concern, they should not be so quick to outsource that task because the BBP successfully informing people depends directly on them being aware of its existence and willing to use it. The EU

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[267] *See supra* notes 9, 87-91 and accompanying text.

[268] *EU Right to Repair Law*, art. 7.

[269] Thomas L. Eovaldi, *The Market for Consumer Product Evaluations: An Analysis and A Proposal*, 79 NW. U. L. REV. 1235, 1248 (1984) ("The case for government subsidization of the production of consumer information begins with the realization that information about consumer products is a public good"); *see also SaferProducts.gov*, U.S. CONSUMER PRODUCT SAFETY COMMISSION (providing information about product safety).

[270] *See, e.g.*, *ZERO SUGAR JUICE DRINKS*, COCA-COLA (advertising zero-sugar lemonade as "the great taste you know and love, ZERO grams of sugar per serving"), https://www.coca-cola.com/us/en/brands/minute-maid/zero-low-sugar-juice-drinks;

[271] *See, e.g.*, *Added Sugars on the Nutrition Facts Label*, U.S. FOOD & DRUG ADMIN. (nutrition label must stipulate the amount of sugar "added during the processing of foods"), https://www.fns.usda.gov/cn/school-nutrition-standards-updates/added-sugars; *Get the Facts: Sugar-Sweetened Beverages and Consumption*, U.S. CENTERS FOR DISEASE CONTROL & PREVENTION (sugary drinks consumption associated with various illnesses), https://www.cdc.gov/nutrition/data-statistics/sugar-sweetened-beverages-intake.html; Yue Huang et al., *Cost-Effectiveness of the US Food and Drug Administration Added Sugar Labeling Policy for Improving Diet and Health*, 139 CIRCULATION 2613 (2019) (projecting that the added sugar labeling requirement would prevent 1.2 million cases of diabetes).

should know this better than most, since the social media service it launched as a "privacy-friendly" rival to X, formerly Twitter, had 18 active accounts after two years.[272] Indeed, the EU now appears to recognize the importance of reducing the effort consumers need to make to get information, as the EU would disseminate information on "repairability of goods *at the point of sale*," which would relieve consumers of having to find it on their own.[273] I propose attaching a QR code to a product's website or packaging. This QR code would take consumers directly to the BBP webpage about the product at the touch of a screen. Firms have long used QR codes to attract customers to their websites without having to type in an address.[274] There remains the issue of whether these QR codes should be mandatory or opt-in, but the EU could legally make them mandatory if it wished. After all, the EU's right to repair law would force firms to start entire websites providing information about repairability,[275] and the EU's product labeling laws are famously stringent, regulating everything from "font size, letter spacing,"[276] and the percentage of a product's package surface that must be covered by mandatory labels.[277]

Making it as easy as possible to access the BBP is for the benefit of not only those who want to be informed, but also those who want to inform others. Consumers often leave online reviews warning others about cases of complexity profiteering, be they cars that require subscription fees paid to a now-bankrupt firm to open a window or the sunroof,[278] TVs that do not work

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[272] James Titcomb, *Brussels Scraps 'Privacy-Friendly' Twitter Rival with Just 18 Active Accounts*, TELEGRAPH (April 29, 2024), https://www.telegraph.co.uk/business/2024/04/29/brussels-scraps-twitter-rival-eu-voice-18-accounts/.

[273] *EU Right to Repair Law*, Recital 5 (italics added for emphasis).

[274] *See, e.g.*, *How to Use a QR Code in Your Marketing Strategy*, ADOBE EXPRESS ("QR codes . . . require a simple scan or click, making it easy for customers to access your online content"), https://www.adobe.com/express/learn/blog/qr-code-marketing.

[275] *EU Right to Repair Law*, art. 5(5).

[276] Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004, 2011 O.J. (L 304) 18, arts. 2(2)(m), 13(2) (food labeling).

[277] Directive 2014/40/EU of the European Parliament and of the Council of 3 April 2014 on the approximation of the laws, regulations and administrative provisions of the Member States concerning the manufacture, presentation and sale of tobacco and related products and repealing Directive 2001/37/EC, 2014 O.J. (L 127), art. 12(2) (tobacco label).

[278] Tim Levin, *Fisker Ocean Owners Are Lawyering Up to Keep their Cars Running*, INSIDEEVS (July 3, 2024), https://insideevs.com/news/725463/fisker-ocean-owners-bankruptcy-support/; Torstein Norum Buggee, *Slik jobbes det for å sikre norske Fisker Ocean-eiere*, TEK.NO (July 4, 2024), https://www.tek.no/nyheter/nyhet/i/VzPezd/slik-jobbes-det-for-aa-sikre-norske-fisker-ocean-eiere (remote functions require monthly fees).

unless the owners agree to mandatory arbitration,[279] or software that locks out customers who already paid unless they allow the firm to use their data to train the firm's AI.[280] Consumers also leave positive reviews of products they see as rejecting complexity profiteering, like phones with removable batteries.[281] By making itself easier to access, the BBP could crowdsource information about products on the market from consumers, as well as have consumers fact-check that information using crowdsourced, open-source tools like Community Notes from X,[282] without needing to rely on particular entities for such a large amount of information. Indeed, a potentially crippling problem with the EU's right to repair website is that it would rely on firms to both supply that information and to disseminate it,[283] which they would lack a meaningful incentive to do. Consumers, on the other hand, have shown interest in leaving useful reviews about instances of complexity profiteering.

Having discussed how to curate the BBP with product reviews, the next step is how to make it as easy as possible for consumers to look up the information they need without having to wade through a mass of irrelevant information. This is a particularly acute problem for the EU's right to repair website, because the sheer mass of information the EU plans to provide may be what discourages consumers from looking up information on the OPR:

> [N]ational online platforms shall . . . include search functions regarding goods, location of repair services, including a map based function, the cross-border provision of services, repair conditions, including the time needed to complete the repair, . . . , availability . . . of ancillary services, including removal, installation and transportation, offered by repairers, and . . . European or national repair quality standards . . . .[284]

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[279] Amelia Schwanke, *Your Roku TV and Streaming Stick Will Stop Working Unless You Agree to Controversial New Terms*, TECHRADAR (Mar. 6, 2024), https://www.techradar.com/televisions/streaming-devices/your-roku-tv-and-streaming-stick-will-stop-working-unless-you-agree-to-controversial-new-terms.

[280] Eli Tan, *When the Terms of Service Change to Make Way for A.I. Training*, N.Y. TIMES (June 26, 2024) (change to terms of service for Adobe software), *available at* https://www.nytimes.com/2024/06/26/technology/terms-service-ai-training.html.

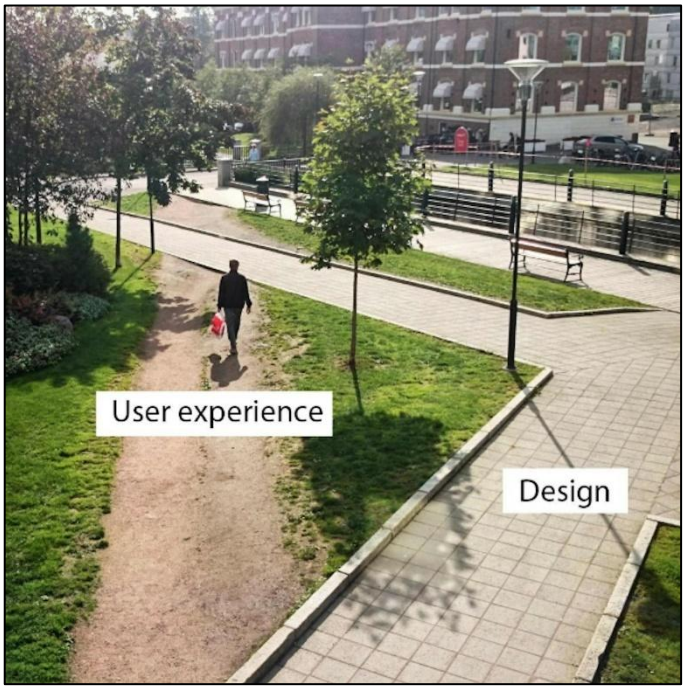
[281] *Another massively underrated aspect of the Samsung Galaxy XCover 6 Pro other than the removable battery is the 4 years OS updates and 5 year security updates!*, Reddit (July 1, 2022), https://www.reddit.com/r/Android/comments/voxctc/another_massively_underrated_aspect_of_the/.

[282] *See supra* notes 38-39 and accompanying discussion.

[283] *EU Right to Repair Law*, art. 5(5) (requiring manufacturers to provide information on a free website); *id*. at art. 6 (requiring manufacturers to present information on "their repair services in an easily accessible, clear and comprehensive manner").

[284] *Id*. at art. 6(a).

Although the EU law does not elaborate on how the search function would work, the devil is yet again in the details. While people considering expensive purchases may accept some inconvenience to get information that would make those purchases worth the price tag, such patience would likely be finite. A classic, even hackneyed, principle of web design is that the design "must minimize the resistance of the user interface to what the user wants to use the [website] for."[285] This "path of least resistance" principle, and what users do when a website flouts it, are represented by the following picture[286]:



Applying this idea to the BBP, if the search function takes too much effort to return useful information, it may drive people away. A text-based search, which government consumer information websites often use,[287] can require precise spelling, symbols such as parentheses, and Boolean operators such as AND, OR, or NOT to return useful results.[288] If a text-based search is simply dumped onto too much information—the amount that the EU seems to have in mind with its repair platform—users may choose not to look anything up.

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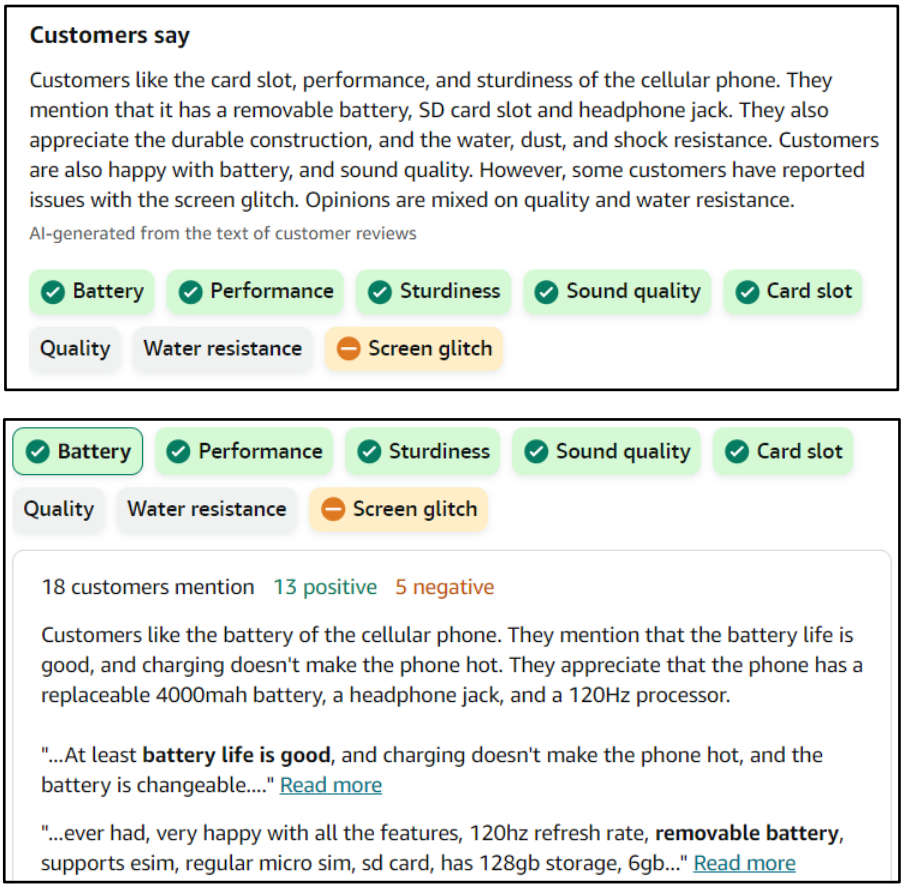
[285] REZA B'FAR, MOBILE COMPUTING PRINCIPLES: DESIGNING AND DEVELOPING MOBILE APPLICATIONS WITH UML AND XML 391 (2005).

[286] *The Past of Least Resistance: Why Users Won't Go Where You Tell Them*, USERTESTING, https://www.usertesting.com/blog/why-users-wont-go-where-you-tell-them.

[287] *See SaferProducts.gov*, *supra* note 269.

[288] *See* KAREN MARKEY & CHERYL KNOTT, ONLINE SEARCHING: A GUIDE TO FINDING QUALITY INFORMATION EFFICIENTLY AND EFFECTIVELY 64, 70, 104 (2023) (discussing how to use spelling variations, symbols, and Boolean operators to improve search results).

Here, AI can help find the path of least resistance. AI can summarize product reviews and identify recurring topics, so that consumers can easily navigate to topics that interest them the most, as in the following example of reviews for an Android smartphone on Amazon. Clicking on a topic—for example, battery—shows only the reviews on that topic, with a summary[289]:



The point is not that text-based search is useless; Amazon offers text-based search[290] in addition to the AI-assisted summary function. The point is that a search function, without more, would not ensure that online portals like the BBP or the EU's right to repair website will actually be used. Text-based search functions could be augmented using AI, so that users can ask questions instead of having to search for keywords, or search for images showing particular items.[291] A search function without such considerations

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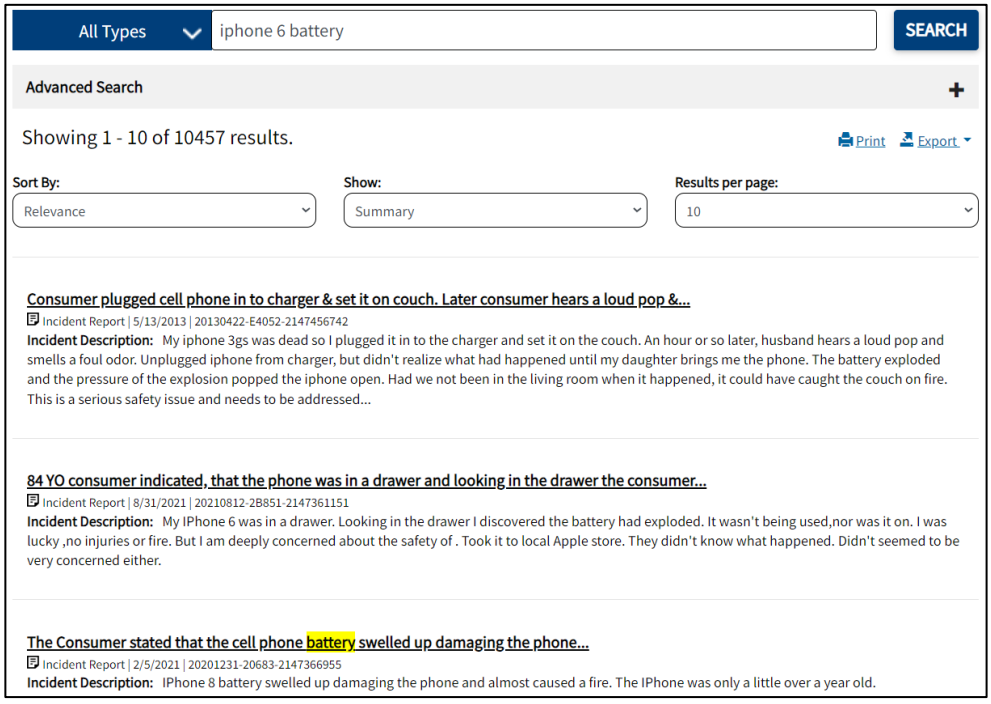
[289] *Samsung Galaxy XCover 6 Pro 5G*, AMAZON, https://www.amazon.com/SAMSUNG-Unlocked-T-Mobile-Cellular-SM-G736UZKEXAA/dp/B0BDBSBBDX/.

[290] *Samsung Galaxy XCover 6 Pro 5G Product Reviews*, AMAZON, https://www.amazon.com/SAMSUNG-Unlocked-T-Mobile-Cellular-SM-G736UZKEXAA/product-reviews/B0BDBSBBDX/.

[291] *See Meta AI*, META (showcasing the AI assistant answering a user's query for salad

can overwhelm users with irrelevant information, driving users away. The U.S. government website SaferProducts.gov, which "[c]ollect[s] reports of harm . . . from consumers about unsafe consumer products" and "publish[es] reports of harm . . . in a searchable public database,"[292] is a good example of how not to design an interface. I searched for "iPhone 6 battery," given that a putative class action for exploding iPhone 6 batteries survived a 12(b)(6) motion to dismiss.[293] Of the first 20 search results, four concerned an iPhone 6 exploding or overheating.[294] The rest concerned the iPhone 3GS, 4, 8, and a phone case that allegedly failed to protect an iPhone from water damage.[295] The screenshot below, without the AI-assisted, precise sorting features of the kind discussed above, indicates the unfriendly nature of the search interface.



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dressing recipes and videos of the recipes), https://ai.meta.com/meta-ai/.

[292] *About SaferProducts.gov*, U.S. CONSUMER PRODUCT SAFETY COMMISSION, https://www.saferproducts.gov/About.

[293] *Franklin v. Apple Inc.*, 2022 WL 2161040 (E.D. Tex., June 15, 2022).

[294] https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1596694; https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1583173; https://www.saferproducts.gov/PublicSearch/Detail?ReportId=3410218; https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1770050.

[295] *See, e.g.*, https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1322332 (iPhone 3GS); https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1397383 (iPhone 4); https://www.saferproducts.gov/PublicSearch/Detail?ReportId=2951758 (iPhone 8); https://www.saferproducts.gov/PublicSearch/Detail?ReportId=1684061 (iPhone 6 phone case allegedly manufactured or retailed by Victoria's Secret).

It is not only government-run websites that neglect the importance of accessibility. Prominent right-to-repair advocate Louis Rossmann is building a website that resembles the BBP in many ways, but without the accessibility considerations. Rossmann's website, called the Consumer Action Task Force, is a crowdsourced wiki intended "to document a new generation of consumer exploitation,"[296] describing specific products or services which users believe are engaging in profiteering or other exploitative practices. Although this wiki offers a text-based search and an A-to-Z list of entries,[297] it offers neither a tool to direct consumers to the website faster such as QR codes, nor a tool intended to make searches easier such as Amazon's AI-based summary of reviews. The following page concerns Adobe "advertising their products . . . as if they were [sold via] a monthly subscription," but in practice "signing [consumers] up for a yearly subscription without [their] knowledge"[298]:

I have so far floated only the QR code as a means of improving access to websites such as the BBP, and mentioned AI only in the context of making searches easier to conduct. But AI could also be used to improve access to the BBP in the near future. AI could be used to recognize a product by its image or packaging, and then to direct a user to the relevant webpage in the BBP. The advantage of using AI to direct users to the relevant BBP webpage would be that this method would bypass having to attach QR codes to the numerous products on the market, whether by having companies opt into the QR code scheme or by imposing it through law. AI has already been put to commercial use for image recognition; for example, cloud services that permit searching for pictures and videos by having AI identify them are already available.[299]

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[296] Consumer Action Task Force, Mission Statement, https://wiki.rossmanngroup.com/wiki/Mission_statement.

[297] *Id.*, *All Pages*, https://wiki.rossmanngroup.com/wiki/Special:AllPages.

[298] *Id.*, Adobe Subscription, https://wiki.rossmanngroup.com/wiki/Adobe_Subscription.

[299] Shade, https://shade.inc/ ("Search your assets with natural language. . . .").

Assume that the BBP begins to successfully inform consumers about which firms are guilty of complexity profiteering and which are not—not necessarily to the point where *everyone* knows that Apple glues batteries into iPhones, but enough people know, such that firms change their baseline assumption about how well-informed consumers are. Whereas Apple could, once upon a time, commit complexity profiteering without most people noticing and ignore the few that do, the BBP informs enough people so that Apple can no longer expect even technologically unsavvy customers to keep buying new iPhones every year. Once the BBP changes firms' assumptions in this way, firms themselves would accelerate the process of informing consumers by advertising their own innocence, because firms would now think that people are sufficiently informed to take their business away from firms engaging in complexity profiteering. This also means that consumers may take their business to firms that actively avoid complexity profiteering.

Firms marketing themselves by painting their competitors as inferior, even nefarious, for engaging in complexity profiteering is a tried and tested strategy. In 2013, when video games were mostly sold on physical discs, Microsoft tried to limit the use of secondhand discs for its Xbox game console. Microsoft would have required users to register newly purchased discs and authenticate them over the internet every 24 hours, so that Microsoft would know if a pre-owned disc is used.[300] This may be an example of complexity profiteering because, by limiting "re-selling, sharing, or renting" games,[301] Microsoft would take profit without adding value. Sony capitalized on the "huge backlash against Microsoft" by marketing the lack of this feature in its PlayStation console. Sony made a 21-second "Official PlayStation Used Game Instructional Video" in which one person simply hands a used disc to another person,[302] in an attempt to "twist[] the bad publicity knife deeper" which resulted in Microsoft renouncing its authentication policy.[303] The strategy of advertising the lack of complexity profiteering continues in 2025, with the carmaker Hyundai advertising itself as the "only automaker to give you a full suite of remote services at no additional cost" which "can save you up to $350 or more per year."[304] Helping consumers vote with their wallets

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[300] Keith Stuart, *Xbox One DRM Restrictions Dropped After Gamer Outcry*, GUARDIAN (June 19, 2013), https://www.theguardian.com/technology/2013/jun/19/xbox-one-drm-second-hand-restrictions-abandoned.

[301] *Id*.

[302] PlayStation, *Official PlayStation Used Game Instructional Video*, YouTube (June 10, 2013), https://www.youtube.com/watch?v=kWSIFh8ICaA.

[303] Roger Cheng, *Sony Twists the Bad Publicity Knife Deeper into Microsoft*, CNET (June 10, 2013), https://www.cnet.com/tech/gaming/sony-twists-the-bad-publicity-knife-deeper-into-microsoft/.

[304] *See* Hyundai, *supra* note 38.

does not require informing every last consumer. Solutions such as the BBP need only inform enough people about complexity profiteering so that firms themselves act on their fear of disgruntled customers taking their business elsewhere. If the BBP becomes sufficiently well known among both firms and consumers, consumers may no longer need to use the BBP to look up any information. The mere existence of the QR code may become a cognitive shortcut indicating the lack of complexity profiteering in a product, similar to how many consumers use famous brand names as signals of high quality.[305]

Enabling consumers to vote with their wallets presents another cost saving compared to complexity prohibitions, in that complexity prohibitions can be based on the state's mistaken views of what the market wants, while people voting with their wallets directly expresses the market's preferences. Complexity prohibitions require firms to design their products in a way the state *believes* consumers want—for example, forcing iPhones to use USB-C cables in the belief that consumers want it.[306] But if the state is mistaken, it would force on the market products that it does not want. This possibility of misjudging market preferences exists not because regulators are inherently incompetent. Rather, this risk of error exists when *any* individual tries to predict which products the entire market "will accept or continue to use."[307] The history of consumer goods is replete with examples of experts, both private and state, making predictions of market preferences which were in retrospect egregiously wrong. Crystal Pepsi, which the company created "[a]fter months of tests and experiments" and believed would "answer[] the new consumer demand for purity," was discontinued "after a little more than a year."[308] Professor Tim Wu, who has served in both state and federal governments,[309] wrote when the iPhone was first released that it will not "turn any industry inside out" and "isn't really revolutionary."[310] The risk of error only increases as the state tries to micromanage the design of more products on the market.[311] Here, an old investment adage is highly applicable: "over the long term, without inside information, no one can beat the market."[312]

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[305] Sabine Baumann, *Media Branding from an Organizational and Management-Centered Perspective*, in HANDBOOK OF MEDIA BRANDING 65, 72 (Gabriel Siegert et al. eds., 2015) ("[B]rand names afford a cognitive shortcut [for] rapid . . . purchase decisions").

[306] *See supra* notes 117-24 and accompanying discussion.

[307] U.S. DEPT. OF AGRIC., THE YEARBOOK OF AGRICULTURE 1950-1951, at 56 (1951).

[308] MATT HAIG, BRAND FAILURES: THE TRUTH ABOUT THE 100 BIGGEST BRANDING MISTAKES OF ALL TIME 43 (2005).

[309] Wu, *supra* note 189.

[310] Wu, *supra* note 188.

[311] *EU Right to Repair Law*, at Annex II (listing, among others, refrigerators, welding equipment, dishwashers, vacuum cleaners, electronic displays, and mobile phones).

[312] ROMESH VAITLINGAM, USING THE FINANCIAL PAGES 55 (6th ed. 2011).

CONCLUSION

Calls to regulate large concentrations of economic power are nothing new. The public sentiment that culminated in the Sherman Act is epitomized by the sentence, "[i]f we will not endure a king as a political power we should not endure a king over the production, transportation, and sale of any of the necessaries of life."[313] This statement, marginally more than a century old, resembles the modern case for regulating firms like Apple or Amazon for fear that they would "foreclose commerce"[314] or create "a super-monopoly—one firm holding multiple monopolies."[315] But the contemporary version of the call for regulation distinguishes itself from its forbear with its increasingly strident tone. Barry Lynn, Executive Director of the Open Markets Institute, has claimed that "Amazon is monopolizing commerce in the United States."[316] Lina Khan, former Federal Trade Commission Chair, argues that big tech threatens democracy by making people "feel coerced in [their] day-to-day life."[317] Nobel laureate Professor Joseph Stiglitz has accused "conservatives," "libertarians," "right of center," and even the "center-left" as "wedded to neoliberalism,"[318] an ideology which, according to him, has "set us on the road to fascism."[319]

It is easy to imagine how such strident, even zealous, rhetoric came to be. Just as many more words are written about hell than heaven, academics naturally spend much more time agonizing over unsolved problems than on congratulating themselves for already-solved problems. The harder a problem is, the deeper the agony and sharper the rhetoric. Facing what one sincerely believes is unadulterated evil, it is only natural to want to spare no coin for an exorcist so that the devil may be condemned to the deepest circle of hell from whence it came. After all, if the sole alternative to regulation is indeed fascism, why *shouldn't* we enact the most stringent regulations imaginable, while pillorying opponents of such efforts as enabling a regression to fascism?

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[313] 21 Cong. Rec. 2457 (1890) (Sen. John Sherman defending the Sherman Act).

[314] Nikolas Guggenberger, *Essential Platforms*, 24 STAN. TECH. L. REV. 237, 247 (2021).

[315] Alex Swerdloff, *Amazon's Purchase of Whole Foods Could Have Massive Implications for Our Food System*, VICE (June 17, 2017) (Prof. Tim Wu commenting on Amazon's acquisition of Whole Foods), https://www.vice.com/en/article/qv4mzm/amazons-purchase-of-whole-foods-could-have-massive-implications-for-our-food-system.

[316] Alex Shepard, *How Amazon Is Changing the Whole Concept of Monopoly*, THE NEW REPUBLIC (June 19, 2017), *available at* https://newrepublic.com/article/143376/amazon-changing-whole-concept-monopoly.

[317] *Dinner Keynote with Jonathan Kanter and Lina Khan: Transcript*, PROMARKET (2024), https://www.promarket.org/2024/05/22/dinner-keynote-with-jonathan-kanter-and-lina-khan-transcript.

[318] JOSEPH E. STIGLITZ, THE ROAD TO FREEDOM: ECONOMICS AND THE GOOD SOCIETY 18 (2024).

[319] *Id*. at 290.

A grave fault with this sentiment and its resulting rhetoric is that it leads to a regulation-at-all-costs mentality, which prevents the sober cost-benefit analysis needed to verify whether we indeed face the catastrophic problem we believe we face. Contrary to Lynn's claim, Amazon is not monopolizing commerce in the United States. "Whole Foods still control[led] just over 1% of the grocery market" in 2022, five years after its acquisition by Amazon,[320] and Amazon lost 2.6 million monthly active users in the U.S. while the Chinese online retailer Temu gained 51.4 million users between September 2022 and January 2024.[321] While Google and Apple are suspected of unfair business practices, people voluntarily using Gmail and iPhones does not constitute coercion. Contrary to Stiglitz's accusation, his fellow Nobel laureates Friedrich Hayek and Milton Friedman never came close to saying that it is "inevitable that *any* set of economic restraints will . . . set[] us on the road to serfdom."[322] Hayek wrote that "in no [economic] system that could be rationally defended would the state just do nothing"[323] while Friedman wrote that "government [regulation of the market] is necessary to preserve our freedom."[324] In short, regulatory maximalism can distort our view of reality.

Were we to fall victim to such regulatory maximalism, we may resort to disproportionate solutions that are both expensive and ineffective. We may enact laws that require regulators to decide for every product which features are intended to thwart repair and which repairs would be *too* expensive,[325] when enabling consumers to vote with their wallets might have been enough to combat predatory design practices.[326] This Article is a call for a paradigm shift in tech law toward a pragmatic approach which accepts that market-based tools may, in at least some cases, provide more control over firms and technological development than direct regulation does. It should be neither controversial nor groundbreaking to say that we should avoid sacrificing life and limb for an exorcist we don't need to fight a devil that doesn't exist—particularly when the actual problem may be a garden-variety case of roaches, for which a few hundred dollars for an exterminator would have sufficed.

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[320] Katie Tarasov, *Amazon Bought Whole Foods Five Years Ago for $13.7 Billion. Here's What's Changed at the High-End Grocer*, CNBC (Aug. 25, 2022), *available at* https://www.cnbc.com/2022/08/25/how-whole-foods-has-changed-in-the-five-years-since-amazon-took-over.html.

[321] Sebastian Herrera, *Amazon's New Focus: Fending Off Rivals Temu and Shein*, WALL ST. J. (Mar. 21, 2024), *available at* https://www.wsj.com/business/retail/amazons-new-focus-fending-off-rivals-temu-and-shein-56ac205.

[322] STIGLITZ, *supra* note 318, at 18 (italics added for emphasis).

[323] FRIEDRICH HAYEK, THE ROAD TO SERFDOM: TEXT AND DOCUMENTS 40 (1944).

[324] MILTON FRIEDMAN, CAPITALISM AND FREEDOM 2 (1962).

[325] *See supra* Section I.B.

[326] *See supra* Part III.