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#### The Advantage is Pharma

#### **In 2013 the Supreme Court erred in *FTC v. Actavis*, forcing the FTC to pursue antitrust violations against “pay-for-delay” settlements in too narrow circumstances. District courts interpret *Actavis* as excluding next generation biologics, leading to runaway monopolization and skyrocketing healthcare costs**

Marmaro 21, Morgan Marmaro is the Editor in Chief of Columbia Journal of Law and Social Problems and has a JD from Columbia Law School, "Molecule Size Doesn't Matter: The Case for Harmonizing Antitrust Treatment of Pay-for-Delay Agreements," Columbia Journal of Law and Social Problems 54, no. 2 (Winter 2021): 169-218

It was not until 2013 that the U.S. Supreme Court addressed the legality and antitrust consequences of these agreements in FTC v. Actavis. 13 The Court held that these pay-for-delay agreements could have anticompetitive effects and were not shielded by patent law from antitrust scrutiny or justified by public policy favoring settlements. 14 Furthermore, it held the judicial standard of review for reverse payment agreements under federal antitrust law was the rule of reason. 15 It rejected the Federal Trade Commission's (FTC) argument that these settlements should be presumptively illegal or per se illegal because the Court could not conclude that these agreements would almost always be anticompetitive, noting that some might be justified for procompetitive reasons. 16

Since Actavis, the FTC has found the number of patent settlement agreements that on their face show pay-for-delay is decreasing, i.e., explicit cash settlement payments, but that the number of settlements with restrictions on generic entry that include other alleged forms of compensation have more than doubled from 2015 to 2016.17 Moreover, the FTC reports do not include every type of pharmaceutical agreement, and suggest that the form of pay-for delay has become more opaque and that any celebration of the demise of the pay-for-delay problem is premature. 18 The FTC only recently began requiring biologic companies to report their patent settlement agreements involving biologic drugs, and no FTC reports have yet been issued.1 9

Efforts to curb collusive pay-for-delay agreements are complicated by the different pharmaceutical manufacturing processes that enhance opportunities to game the system and by divergent regulatory and reporting regimes that can create undue confusion when interpreting and applying related case law. In large part, these differences are due to two different forms of pharmaceuticals - small and large molecule drugs - each with their own pathway to regulatory approval.2 0

Small molecule drugs are synthetic and have simpler, well-defined manufacturing processes. 21 Many of the drugs on the market, such as Aspirin, are small molecule drugs. 22 Large molecule drugs, also known as biologics, are generally produced using larger, complex molecules in living cells and are the fastest growing part of the drug market, often launched at eye-popping prices. 23 Not only do biologics offer some revolutionary advances in treating and curing previously incurable diseases, including some cancers, but also the biologics market is expected to increase from $239.2 billion in 2020 to $464.7 billion worldwide by 2023.24

Unlike small molecule drugs that can be replicated with relatively greater ease and confidence, large molecule biologics involve between dozens and hundreds of operating procedure controls to create the specific conditions that ensure an unexpected factor does not alter the resulting product.25 Not only must a manufacturer know what components to use, it must also know the precise sequence to assemble those pieces. 26 This also means that any attempts to make a "copycat" or "generic" version of a biologic drug - i.e., biosimilars - are more expensive. On average, some estimate that the cost of developing a generic is roughly $2 million, while developing a biosimilar may require $200 million or more. 27

Though biosimilars compete with biologics as generics compete with brands, biosimilars are subject to different regulations and state laws governing when and how they can be substituted or interchanged with the branded drug at the doctor and pharmacy level. 28 With small molecule drugs, the FDA determines whether the generic is a reliable copy or substitute for a brand drug (or an AB-rated generic); under many state laws, this FDA determination allows and often mandates a pharmacy to substitute a generic for a prescribed brand drug. 29 As a result, generics have an almost automatic path to competition in many situations.

In contrast, the FDA only recently developed the regulations allowing it to determine that a biosimilar is "interchangeable" with a biologic.30 As of September 2020, the FDA has yet to designate a single biosimilar or biologic drug in the U.S as "interchangeable."3 1 Indeed, the FDA has been relatively slow to even approve biologic and biosimilar drugs for sale in the U.S., making biosimilar introduction relatively slow in the U.S compared to Europe. 32 While there are seventy-one biosimilar drugs approved in Europe as of January 2020, only twenty-six biosimilars had been approved in the U.S. 33

But even when the FDA actually approves a biosimilar as an "interchangeable" drug, most states do not have laws that permit or mandate the substitution of the "interchangeable" drug with the biologic. 34 The pharmaceutical industry successfully lobbied for laws requiring naming conventions for biosimilar drugs that make it difficult for pharmacists to identify similar biologic drugs.35 States, for their part, have generally not updated their laws to provide more substitution of biosimilars or those drugs with interchangeability designations.

However, with the end of the "golden age" for small-molecule brand drugs in sight and $200 billion in brand sales subject to generic competition by 2025, companies increasingly see biologics and biosimilars as the future of the pharmaceutical market.36 As explained infra, biologic drugs' large price tag derives, in part, from a lack of meaningful competition in the U.S. and few pricing constraints. 37 Some $67 billion of the biologic market is vulnerable to biosimilar competition as major patents are set to expire in 2020;38 the use of patents and pay-for-delay agreements by biologics companies remains a potent threat to any real competition.

For instance, Humira has been the top-selling rheumatoid arthritis and immunology drug in the U.S. for more than six years, generating over $20 billion in sales for 2018 alone.39 Popularity and high sales' volume alone do not explain the enormous revenues, which can be primarily attributed to its high price: in 2020, $72,000 per patient annually. 40 Yet, in 2018, AbbVie Humira's manufacturer - cut Humira's price by 80% in Europe once biosimilar versions became available. 41 Meanwhile, Humira has entered a number of settlement agreements with biosimilar competitors, two of whom had already received FDA-approval in 2016 and 2017.42 None of the biosimilar companies will enter the U.S. market until 2023, leaving U.S. consumers to pay up to 500% more than their European counterparts for the same drug. 43 In contrast, the same biosimilar companies received entry dates into European markets more than five years before entry in the U.S.44 In total, eight companies with Humira biosimilars have settled with AbbVie, extending Humira's U.S. monopoly, and its supracompetitive prices in the U.S., seven years past its main ingredient's patent expiry date. 45

A class action, In re Humira (Adalimumab) Antitrust Litigation,46 alleges that AbbVie's multiple agreements are actually market allocating agreements and settlements qualifying as reverse payments. As of this writing, the In re Humira litigation is undergoing appeal after a district court ruled in favor of AbbVie, noting that while the behaviors seem unsavory, they were legal "exploited advantages" derived from the current regulatory system.47 The court went further astray, finding that the agreements were not anticompetitive, and in contradiction with Actavis's rejection of the scope of the patent doctrine, did so by relying upon the alleged strength of AbbVie's Humira patents.48 But neither the parties nor the Court in In re Humira questioned the basic application of Actavis to the agreements in this case. Though the In re Humira district court dismissed the case in favor of defendants,49 this Note argues that the In re Humira district court was correct to engage in an Actavis analysis but did so incorrectly.

A constrictive reading of Actavis to not include biologics, despite similar economic incentives to game the system and collusively divide the markets, would undoubtedly result in the proliferation of collusive biologic settlement agreements that will increase the already staggering biologic prices. There is clear congressional intent that supports treating biologic and small molecule collusive agreements under the same standards.50 Further, using the ongoing In re Humira litigation as a framing device, an opportunity for courts to explicitly determine whether and how to apply the Actavis framework to biologic drug settlements, this Note will demonstrate how the reasoning and analysis of Actavis applies to qualifying settlements in the biologic sphere and is consistent with precedent, congressional intent, and public policy.

While differences between biologics and small molecule pharmaceutical production warrant different FDA manufacturing procedures, 51 recent and ongoing legislative proposals addressing pay-for-delay agreements apply the same legal standards to adjudication of agreements for biologic and small molecule drug manufacturers. 52 Some commentators, however, have advocated a narrow interpretation of Actavis to apply only to small molecule drugs53 because the Court only discusses the relevant regulatory framework for small molecule drugs in that case. 54 They argue that the Actavis result was founded and based on the language and intent of the Hatch-Waxman Act. 55 Just as the courts then spent years litigating whether Actavis only implicated cash-only "payments," 56 savvy pharmaceutical attorneys are likely to argue that Actavis should apply only to drugs covered by the Hatch-Waxman Act.

Part II will first discuss various forms of antitrust abuses that arise in the pharmaceutical space and are often utilized as part of or together with reverse payment agreements. It goes on to explain the legal and regulatory backgrounds of small and large molecule drugs, focusing on how the biologic regulatory regime differs. Part III then discusses the consequences of lax antitrust scrutiny on pharmaceuticals, and finishes with the allegations, arguments, and findings currently on appeal in In re Humira. Lastly, Part IV proposes a two-fold solution to the problems posed by Actavis's lack of legal clarity. First, there must be regulation or precedent that clearly indicates that for antitrust purposes, biologic settlement agreements should be subject to the same antitrust scrutiny as those concerning small molecule drugs. In re Humira provides the perfect opportunity; and as the Part IV analysis will show, applying Actavis to biologics is in the spirit of the law, aligns with public policy, and follows precedent - despite the In re Humira district court ruling in favor of the defendants. Second, this Note suggests a need for a corresponding legislative solution. This Note's purpose is to demonstrate that the way a drug is manufactured, approved, or allowed to compete does not alter the application of antitrust law seeking to rid the market of collusive agreements between rivals.

#### Early clarity is key---companies are watching this litigation. If not reversed, biologic companies will copy AbbVie’s strategy. That crushes innovation.

Balto, 21

(David, leading expert on healthcare competition and regulation and an antitrust attorney as well as the Former Assistant Director of Policy and Evaluation at the FTC, Brief Of Amici Curiae Consumer Action And U.S. Public Interest Research Group In Support Of Plaintiffs-Appellants, Ufcw Local 1500 Welfare Fund, et al., v. Abbvie Inc., et al, In The United States Court Of Appeals For The Seventh Circuit, Filed 10/14/20, WestLaw)

The District Court’s dismissal will only embolden other drug manufacturers to use the patent process, along with the courts and reverse settlement payments, as tools to delay the entry of rivals.6 The District Court’s decision incentivizes drug manufacturers not to innovate but rather to focus on tweaking their patent estates to extend the life of their monopolies and then suing rivals for alleged patent infringement and seeking reverse payments.7 Indeed, one of the most effective ways for a brand manufacturer to maintain market power is through the abuse of government processes.8 The cost to the brand manufacturer engaging in such abuse typically is minimal, while the anticompetitive effects resulting from such abuse often are significant.9 Approximately 40 years ago, then-Circuit Court Judge Robert Bork observed that “[p]redation by abuse of governmental procedures, including administrative and judicial processes, presents an increasingly dangerous threat to competition.”10 Anticompetitive conduct through regulatory and judicial abuse can be especially pernicious. In a healthy market, when a company obtains a dominant position through competition in the marketplace, we can expect other competitors to arise and possibly displace them. But no natural competitive force can displace dominance acquired through abuse of the regulatory and judicial processes. That is especially the case in the pharmaceutical industry where litigation and regulatory approval are necessities to market entry. Here, AbbVie’s successful extension of its Humira monopoly along with the reverse settlements kept biosimilars out of the U.S. market in exchange for an early entry in Europe. If this strategy is found to be legal under the antitrust laws, it will have serious ramifications for the cost of prescription drugs going forward. Biologics such as AbbVie’s Humira are essential for the treatment of serious debilitating and life-threatening diseases. While fewer than 2% of all U.S. prescriptions are for biologic drugs, they account for almost 40% of all U.S. drug spending.11 In other words, biologics are extremely expensive, and they are the fastest-growing segment of drug spending in the United States. When Congress passed the Biologics Price Competition and Innovation Act ten years ago, the expectation was that a robust biosimilar market would substantially lower the price of biologic drugs. Indeed, there were estimates indicating that the cost savings to the U.S. healthcare system from the use of biosimilars could have been up to hundreds of billions of dollars over a decade.12 One study suggests that there may be a significant uptick in the rate of biosimilar approvals over the next few years which have the potential to generate nearly $100 billion in cost savings.13 However, a number of obstacles including anticompetitive patent thicket strategies and reverse settlement agreements have delayed and may in the future delay many biosimilars from entering and competing in the United States. Unfortunately, from 2010 to 2019, biosimilars have only saved U.S. patients about $1.8 billion.14 If Americans could have bought FDA-approved biosimilars over the past four years, they could have saved over $9 billion.15 Thus, patients’ access to biosimilar drugs is critically important to lowering overall drug spending and costs to patients in the United States. Disputes between branded biologics and biosimilars will continue as patent thickets prevent biosimilar entry after the expiration of the original patents on a drug. A recent report analyzing the twelve best selling drugs in the United States revealed that pharmaceutical manufacturers of the brand drugs filed on average 125 patent applications to extend their monopolies “far beyond the twenty years of protection intended under U.S. patent law” in an effort to preserve their monopoly pricing.16 As if to add insult to injury, drug manufacturers are also increasing prescription drug prices even as they extend the life of their monopolies.17 Make no mistake the District Court’s decision with respect to AbbVie’s conduct will have huge ramifications going forward. AbbVie is the most egregious violator of the patent thicket strategy that resulted in a reverse settlement and the harm caused to U.S. payors and consumers is clear. AbbVie’s economic incentive is to prolong the life of Humira, the world’s number one selling drug for as long as it can. Humira’s list price in the United States more than tripled from 2006 to 2017, with the list price soaring from $16,636 to $58,612 for a one-year supply;18 and from 2012 to 2018, Humira’s price increased by 144%.19 Neither inflation nor higher manufacturing costs explain these price increases. As the record demonstrates, most of Humira’s U.S. patents were set to expire in 2016, but AbbVie engaged in a patent thicket strategy that allowed the company to prolong its Humira monopoly for years beyond what Congress intended. And while biosimilar manufacturers challenged AbbVie’s patent estate, they all eventually agreed to delay their entry into the U.S. market until 2023 in exchange for entering the European market much sooner. The predictable result is that in Europe, where biosimilars have entered the market without obstacles, biologics such as AbbVie’s branded blockbuster Humira has been discounted as much as 80%.20 AbbVie offered these discounts to maintain its sales in the face of biosimilar competition. In the United States, however, the price of Humira has continued to climb due to the lack of biosimilars. Biologic drug manufacturers are watching this appeal closely and if the District Court’s opinion is not reversed, they will have every incentive to copy AbbVie’s strategy. If the District Court’s opinion is not reversed, their incentive to copy AbbVie’s strategy which will result in widespread harm as well as higher drug prices for payors and patients. The price differential for Humira in Europe versus the United States makes one thing startingly clear: patent thickets and pay for delay strategies harm payors and patients who are effectively forced to use more expensive biologics when more affordable medicines should be available – indeed are available for payors and patients that happen to be on the winning land-mass of AbbVie’s devil bargain. In addition, the federal government as well as taxpayers are harmed as well because government programs such as Medicare suffer as they must pay artificially inflated monopoly prices. There is also harm to manufacturers of biosimilars. They suffer loss of sales, loss of investment, damage to brand and reputation, and loss of business opportunity. Finally, there could be a real impact on the research and development of more affordable medicines. If drug manufacturers use AbbVie’s anticompetitive strategy, it will affect the decisions of biosimilar manufacturers to launch new products into new markets going forward despite already investing heavily into research and development and some biosimilar manufacturers may decide not to continue with any R&D efforts or to launch new biosimilar products. These decisions to abandon R&D efforts or to hold back the launch of biosimilars unquestionably harm competition, payors, and patients.

#### **Even individual pay for delay agreements cost consumers billions** of dollars in losses, only antitrust regulation makes healthcare accessible

Deb, 20

(Chaarushena, Yale Law School, and Gregory Curfman, MD, Deputy Editor, JAMA, “Relentless Prescription Drug Price Increases”, *JAMA 323*(9): 826-828, 03-03-2020, doi:10.1001/jama.2020.0359)\\JM

One in 4 people in the US has difficulty paying the cost of their prescription medications. This stark fact was recently reported in a 2019 Kaiser Family Foundation public opinion poll among a nationally representative random sample of 1205 adults.1 Persons who reported having the greatest difficulty affording their prescription drugs were those who most needed them, including those who took 4 or more prescription drugs, spent $100 or more per month on their drugs, and reported being in fair or poor health. In response to relentless increases in prescription drug prices and the burden they place on consumers, the federal government has begun to take some action. The House of Representatives passed H.R.3, The Elijah E. Cummings Lower Drug Costs Now Act, which would allow Medicare to negotiate the price of 250 drugs per year; cap payments for drugs in the US at 120% of the average prices in 6 other countries; prohibit drug price increases beyond the rate of inflation; allow private insurers to purchase drugs at Medicare’s negotiated price; and cap out-of-pocket drug spending for older adults at $2000 annually. But this comprehensive legislation is very unlikely to pass in the Senate, as Majority Leader Mitch McConnell, referring to drug price negotiation as “socialist price controls,”2 has made it clear that he will not take it up. Meanwhile, Senators Chuck Grassley (R-IA) and Ron Wyden (D-OR) have introduced bipartisan drug pricing legislation that, like the House bill, would place penalties on pharmaceutical companies if they raise prices faster than inflation. However, this provision in the bill, considered crucial by the sponsors, is also its greatest obstacle to passage, as many Republican senators oppose the idea as a form of government price setting. Thus, without substantial compromise, the prospects for passage of this bill in a Republican Senate are not bright. The Trump administration has proffered its own proposal to control the prices of prescription drugs, which is focused primarily on facilitating importation of prescription drugs from Canada. Senator Bernie Sanders (I-VT) has introduced drug importation legislation in the Senate, the Affordable and Safe Prescription Drug Importation Act, which the Congressional Budget Office estimates would save $7 billion over the next decade. However, both Canadian officials and the pharmaceutical industry are strongly opposed to these importation proposals, creating major hurdles for passage. With the fate of federal initiatives to control drug prices uncertain, individual states have begun to focus on this issue. Since 2015, a total of 35 bills have been passed in 22 states that include provisions requiring drug price transparency to aid consumers in purchasing prescription drugs.3 However, these state actions generally do not help patients because they do not require the disclosure of real transaction prices at each stage of the drug distribution process. The Trump administration has also proposed a price transparency rule, whereby pharmaceutical companies would be required to include their wholesale acquisition (list) prices in drug advertisements. This proposal, however, is unlikely to survive a legal challenge by the industry. In another state-level proposal, Governor Gavin Newsom of California recently signed into law a bill, Preserving Access to Affordable Drugs, banning pay-for-delay deals. Such tactics involve payments from brand-name companies to generic companies to keep lower-cost generic drugs off the market, and both brand-name and generic companies profit from these arrangements. These arrangements are commonplace, and with the elimination of market competition, brand-name companies are at liberty to keep their prices high—as high as the market will bear. Although the Supreme Court ruled in Federal Trade Commission v Actavis (2013)4 that such deals may be challenged as anticompetitive, California has been sued on constitutional grounds that the state law banning pay-for-delay interferes with interstate commerce. For now, pending the outcome of the lawsuit, the law remains in effect, but it is uncertain if it will ultimately survive legal challenge. Governor Newsom also recently announced another novel development, in which California will explore manufacturing its own generic drugs as a way of controlling costs to consumers. Exactly how such an ambitious plan would be implemented, however, remains to be determined. In the current presidential election year, the high cost of prescription drugs has emerged as a major campaign issue for all the candidates. In this issue of JAMA, 3 original research articles address different aspects of the prescription drug price quandary. Also relevant to this discussion is a fourth article, published simultaneously in JAMA Internal Medicine, that describes the substantial expenditures by the pharmaceutical industry on political donations and lobbying between 1999 and 2018.5 The pharmaceutical industry often points to the high costs of research and development (R&D) required for the creation of innovative therapies as justification for high pricing, and in the Kaiser Family Foundation opinion poll, 69% of respondents believed that R&D costs were an important contributing factor to high prescription drug costs.1 A previous study of large pharmaceutical companies reported that the estimated R&D cost to bring a new drug to market was $2.87 billion.6 This study came under sharp criticism because the data on which it was based were considered to be “proprietary” and, therefore, were not provided in the published article.7 A new analysis by Wouters and colleagues8 in this issue of JAMA relied only on publicly available data, which were made available primarily by smaller biotechnology companies. Examining 63 of 355 new drugs approved by the US Food and Drug Administration between 2009 and 2018, the authors reported an estimated median R&D cost to bring a new drug to market of $985 million. Although this figure is substantially lower than the previously reported R&D cost for larger companies, it is still a considerable amount for smaller, start-up biotechnology companies to recoup from a new product. In a second article in this issue, Ledley and colleagues9 examined the profitability of 35 large pharmaceutical companies, as compared with 357 nonpharmaceutical companies, listed among Standard & Poor 500 companies between 2000 and 2018. During this period, the median profit margin for large pharmaceutical companies was nearly double that of nonpharmaceutical companies. Specifically, the median net income (earnings) expressed as a fraction of revenue was 13.8% for pharmaceutical companies compared with 7.7% for nonpharmaceutical companies. Although the difference narrowed over the last 5 years, pharmaceutical companies still remained more profitable than nonpharmaceutical companies. The authors also noted that the median annual net income margins of Apple, Alphabet, and Microsoft, technology giants that are increasingly involved in health care, were 19.2%, 21.9%, and 27.6%, respectively, compared with 13.8% for pharmaceutical companies. In the Kaiser Family Foundation opinion poll, 4 of 5 respondents believed that drug company profits are a major factor contributing to the high cost of prescription drugs.1 Thus, most US residents perceive that pharmaceutical companies maintain their high profit margins by keeping prices high. In a third article in this issue, Hernandez and colleagues10 reported on trends in both list prices (defined as the wholesale acquisition price) and net prices (the price after discounts and rebates) for 602 brand-name drugs from 2007 to 2018. Inflation-adjusted list prices increased by 159%, and net prices increased by 60%. Increases in discounts offset 62% of increases in list prices, but there was wide variability among different classes of drugs. Pharmaceutical companies offer discounts to payers to secure a favorable position for their drugs on the payers’ formularies and to stave off competition. Some companies that manufacture brand-name biologic products, for instance, may provide discounts to keep biosimilar products off formularies or to improve the positioning of their other drugs. For example, attempting to establish another robust income stream, biologics manufacturer AbbVie now discounts Humira, which accounts for more than half of its revenue, to secure better formulary positioning of its new biologic for plaque psoriasis, Skyrizi. The financial strategy for some products of some pharmaceutical companies follows this scenario: increase list prices; offer discounts to partially offset the list price increases; restrain competition and enhance market share through optimal formulary placement; and increase volume of sales. It is noteworthy that patients do not receive discounts, and patients who are uninsured, covered by high-deductible plans, or are in the deductible phase of their coverage, must pay list prices. Also, coinsurance payments, which may be required for some more expensive specialty drugs, are determined based on a percentage of the list price. The pharmaceutical industry just announced prescription drug price increases for 2020. According to the health care research firm 3 Axis Advisors, prices were increased for nearly 500 drugs, with an average price increase of 5.17%.11 To mitigate public criticism, most of the price increases were kept below 10%. The list price of the world’s best-selling drug, adalimumab (Humira), was increased by AbbVie by 7.4% for 2020, which adds to a 19.1% increase in list price for years 2018 and 2019. The 2018 price increase alone was estimated to have added $1 billion to US health care costs. In a recent analysis, the Institute for Clinical and Economic Review determined there was insufficient clinical evidence to justify such a large price increase.12 Humira serves as a prime example of the aggressive tactics that may be used by some pharmaceutical companies to maintain high drug prices. In response to these price hikes for Humira, AbbVie has recently been the subject of a series of groundbreaking class-action lawsuits. Insurance payers and workers’ unions allege that AbbVie created a “patent thicket” around the monoclonal antibody therapy, thereby acting in bad faith to quash competition from Humira biosimilars.13 The original Humira patent expired in 2016, but AbbVie has been able to stave off biosimilar market entry by filing more than 100 follow-on patents that extend AbbVie’s monopoly beyond 2030. It is not uncommon for drugs to be protected by multiple patents, but the Humira patent thicket is extreme and allows AbbVie to aggressively extend its high monopoly pricing. A second claim in the lawsuits against AbbVie is that the company allegedly used “pay-for-delay” tactics to negotiate later market entry dates with biosimilar competitors. Pay-for-delay agreements in the pharmaceutical industry have been controversial for years, but the notion of a “patent thicket” greatly exacerbates the issue because the normal route for generics and biosimilars to enter the market is through patent litigation. Typically, a generic or biosimilar drug maker will try to enter the market prior to the patent term expiration date by asserting that the patents they would be infringing are, in fact, invalid. AbbVie contended it would continue to sue biosimilar manufacturers for infringement using its full complement of patents, pushing market entry dates well into the 2030s, leading the biosimilar companies to simply give up and settle the litigation. These settlements will likely allow AbbVie to continue instituting price increases for Humira. The pioneering class-action lawsuits, filed on behalf of the people who actually bear the burden of increasing drug prices, represents a novel way of challenging the drug industry with the aim of increasing access to expensive medicine for all patients. When legislative solutions are unsettled, this innovative lawsuit could establish a new legal pathway for curtailing relentless price increases for expensive prescription drugs. Collectively, the articles in the current issues of JAMA and JAMA Internal Medicine, along with the illustrated cover of JAMA, paint a concerning picture about the relationships among rising drug prices, pharmaceutical industry profits, uncertainty about pharmaceutical R&D costs, and lobbying and political donations to gain influence with legislators. We anticipate that publication of this information will further stimulate the ongoing national debate on prescription drugs and help rein in increasing drug prices while sustaining innovation in drug development, which is so critical to the health of individuals both in the US and around the world.

#### Pay-for-delay raises costs, reduces access, and slows innovation

Shabbir, 21

(Ruqayyah, Ivey Business School at Western University, “The Delay of Competition in the Pharmaceutical Industry: A Closer Look at the Pharmaceutical Giants”, *Western Undergraduate Economics Review,* 20, (2021), https://ojs.lib.uwo.ca/index.php/wuer/article/view/14025)\\JM

Lastly, one of the most controversial and recent acquisitions in the pharmaceutical industry was AbbVie’s purchase of Allergan. In 2019, the American biopharmaceutical company, AbbVie, officially acquired Allergan, an Irish pharmaceutical company. Prior to the official acquisition, there was significant concern regarding how drug prices and future drug innovation would be affected as a result. This concern was substantial enough to bring together 17 consumer advocacy groups. This collective group expressed their worries to the Federal Trade Commission (FTC), based on historical information about AbbVie and the broader pharmaceutical industry. Specifically, the group noted that between 2006 and 2017, AbbVie had tripled its price for Humira (generic name: adalimumab), and “neither inflation, nor higher manufacturing costs could explain these price increases” (Mogin, 2019). Based on these voiced concerns, it would have been important to question what AbbVie would be capable of once it acquired Allergan’s drug portfolio. In addition to expressing concern, the group presented data on recent trends in the pharmaceutical industry. Among data on price increases, there was also concern that AbbVie’s acquisition would hamper innovation, reducing how much firms spend on research and development (R&D). It has been noted that “the share of new drugs coming from the top twenty big pharma firms has dropped every year since 2013, from over 60% to just above 30% in 2018”(Mogin, 2019). Simply stated, large firms are acquiring smaller firms to increase their drug portfolio, rather than working to benefit consumers through increased innovation and R&D. With a focus on mergers and acquisitions (M&A), innovation has become a secondary goal. This directly impacts consumers as it has taken firms longer to introduce new drugs and when these new drugs come to market, they come much later. Firms are simply taking the “easy route” to becoming pharma giants, once again at the detriment of consumers. With discussion concentrated around the time delay in bringing affordable and innovative drugs to market, it is important to introduce the role of pay-for-delay schemes. The previous three case analyses illustrate how certain strategies can still harm consumers through hindered competition, even if there is no overall “lessening of competition” according to the respective country’s competition law. Unlike the tactics used by the firms discussed above, the pay-for-delay tactic is a way for patent-holders (“brands”) to stifle competition in a much more direct way. The pay-for-delay scheme involves brands offering settlements to generics, deterring them from developing and marketing generic versions of their patented drugs once the patent expires. Pay-for-delay deals have “cost consumers and taxpayers $3.5 billion in higher drug costs every year” (Federal Trade Commission, 2019). Recognizing this, the United States’ FTC has made it its priority to prevent these schemes from injuring competition. The controversy surrounding each of the cases discussed above highlights the need for a deeper analysis of competition cases, specifically with respect to how the actions of firms directly and indirectly affect consumers. Although it was found that these firms did not lessen competition, the difficulties they caused other firms and potential entrants resulted in delayed entry of competitors. In the case of Celgene, generics were repeatedly denied access to CRPs, which hindered their ability to validate their drugs and bring them to market. Pfizer engaged in various exclusive dealing arrangements to deter the entry of generics, impeding their ability to sell appropriate quantities once they enter. Finally, AbbVie’s acquisition of Allergan caused great concern among consumers, as past data has shown higher prices, less competition, and slowed innovation as a likely result. With generics entering the industry later than expected and with higher costs due to the strategies pursued by major pharma brands, consumers cannot access cheap drugs in a timely manner. Unfortunately, a population that desperately requires medicine, but can only afford generic versions, will always exist. Therefore, even if competition eventually builds, this does not necessarily mean that consumers will no longer be affected during the period of delay. According to a paper addressed by the NCBI, “1 in 5 Americans do not fill prescription drugs because of prohibitive costs” (Carrier et al., 2016). From a global perspective, this statistic reflects the staggering reality of many other countries. Competition law is often designed in a generalized manner, such that every firm in every industry is subject to the same laws. This helps in promoting fairness and ensuring justice. However, it is important to note that medicine is unlike many other consumer goods. Although the nuanced nature of the medical industry is being increasingly recognized and competition law has recently evolved in the pharmaceutical industry, there must be greater discipline. The three cases discussed in this paper are just a handful of the many cases that do not lessen competition per se, but surely delay competition and the introduction of affordable drugs to consumers in a timely manner.

#### Pharmaceutical innovation is crucial to solving global threats from infectious diseases and bioterror. Alternatives to market-based incentives are guaranteed to fail.

Marjanovic, 20

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We need to ensure scalable and sustainable approaches for pharmaceutical innovation in response to infectious disease threats to public health As key actors in the healthcare innovation landscape, pharmaceutical and life sciences companies have been called on to develop medicines, vaccines and diagnostics for pressing public health challenges. The COVID-19 crisis is one such challenge, but there are many others. For example, MERS, SARS, Ebola, Zika and avian and swine flu are also infectious diseases that represent public health threats. Infectious agents such as anthrax, smallpox and tularemia could present threats in a bioterrorism context.1 The general threat to public health that is posed by antimicrobial resistance is also well-recognised as an area in need of pharmaceutical innovation. Innovating in response to these challenges does not always align well with pharmaceutical industry commercial models, shareholder expectations and competition within the industry. However, the expertise, networks and infrastructure that industry has within its reach, as well as public expectations and the moral imperative, make pharmaceutical companies and the wider life sciences sector an indispensable partner in the search for solutions that save lives. This perspective argues for the need to establish more sustainable and scalable ways of incentivising pharmaceutical innovation in response to infectious disease threats to public health. It considers both past and current examples of efforts to mobilise pharmaceutical innovation in high commercial risk areas, including in the context of current efforts to respond to the COVID-19 pandemic. In global pandemic crises like COVID-19, the urgency and scale of the crisis – as well as the spotlight placed on pharmaceutical companies – mean that contributing to the search for effective medicines, vaccines or diagnostics is essential for socially responsible companies in the sector. 2 It is therefore unsurprising that we are seeing industry-wide efforts unfold at unprecedented scale and pace. Whereas there is always scope for more activity, industry is currently contributing in a variety of ways. Examples include pharmaceutical companies donating existing compounds to assess their utility in the fight against COVID19; screening existing compound libraries in-house or with partners to see if they can be repurposed; accelerating trials for potentially effective medicine or vaccine candidates; and in some cases rapidly accelerating in-house research and development to discover new treatments or vaccine agents and develop diagnostics tests.3,4 Pharmaceutical companies are collaborating with each other in some of these efforts and participating in global R&D partnerships (such as the Innovative Medicines Initiative effort to accelerate the development of potential therapies for COVID-19) and supporting national efforts to expand diagnosis and testing capacity and ensure affordable and ready access to potential solutions.3,5,6 The primary purpose of such innovation is to benefit patients and wider population health. Although there are also reputational benefits from involvement that can be realised across the industry, there are likely to be relatively few companies that are ‘commercial’ winners. Those who might gain substantial revenues will be under pressure not to be seen as profiting from the pandemic. In the United Kingdom for example, GSK has stated that it does not expect to profit from its COVID-19 related activities and that any gains will be invested in supporting research and long-term pandemic preparedness, as well as in developing products that would be affordable in the world’s poorest countries.7 Similarly, in the United States AbbVie has waived intellectual property rights for an existing combination product that is being tested for therapeutic potential against COVID-19, which would support affordability and allow for a supply of generics.8,9 Johnson & Johnson has stated that its potential vaccine – which is expected to begin trials – will be available on a not-for-profit basis during the pandemic.10 Pharma is mobilising substantial efforts to rise to the COVID-19 challenge at hand. However, we need to consider how pharmaceutical innovation for responding to emerging infectious diseases can best be enabled beyond the current crisis. Many public health threats (including those associated with other infectious diseases, bioterrorism agents and antimicrobial resistance) are urgently in need of pharmaceutical innovation, even if their impacts are not as visible to society as COVID-19 is in the immediate term. The pharmaceutical industry has responded to previous public health emergencies associated with infectious disease in recent times – for example those associated with Ebola and Zika outbreaks.11 However, it has done so to a lesser scale than for COVID-19 and with contributions from fewer companies. Similarly, levels of activity in response to the threat of antimicrobial resistance are still low.12 There are important policy questions as to whether – and how – industry could engage with such public health threats to an even greater extent under improved innovation conditions. The COVID-19 pandemic is a game-changer among global public health threats. The risk to human life (both in terms of morbidity and quality of life), the economic risks, the epidemiology of the disease and speed of escalation have led to a crisis-response by many governments around the world. This has in turn influenced the immediate industry efforts. Many other infectious disease threats may not manifest as crises in the short term and in the same way as COVID-19, but they could nevertheless escalate. They are not considered to be crises from a short term perspective because they are contained to specific regions and affect fewer people at present – or are re-emerging (e.g. Ebola) – or their impacts have not yet materialised at a scale that would qualify as an immediate crisis (e.g. growing risks of antimicrobial resistance to some infectious pathogens). However, such diseases and issues are recognised as global threats that could become crises in the future.13 The emerging threats raise important policy questions about how government and the pharmaceutical industry can work together to ensure that pharmaceutical industry innovation is incentivised sustainably and at scale. This is important to help mitigate against current and emerging threats becoming crises further down the line. At present, there are no clear and specific criteria to determine when a disease can trigger the types of healthcare-innovation-related policy actions that have been deployed in response to the COVID-19 crisis. For example, this applies to criteria for securing financial resources for innovation-related activities, reforming regulation to accelerate trials and regulatory approval processes, and securing reimbursement mechanisms that help enable industry engagement and the search for rapid solutions. The WHO guidance on what constitutes a pandemic phase does provide guidance on national policy response options, but not specifically as they relate to healthcare innovation activity.14 There are also questions as to whether such policy initiatives and incentives should only be applied in crisis situations, or also as part of proactive government and industry efforts to innovate in the areas of public health threats in order to prevent future global calamities. A crisis and ‘emergency mode’ response may be inevitable for some diseases, but more can be done to mitigate against the need for such a response – especially in cases where emerging threats and their consequences can be foreseen and are known to be a risk. We need to anticipate and act now in terms of how we plan and incentivise better for the future, and how we distinguish between different types of infectious disease threats and phases in framing incentives and regulation. Innovative financial instruments must be integral to any sustainable and scalable approach to incentivising pharmaceutical innovation for tackling emerging threats to public health from infectious diseases The pharmaceutical industry has a responsibility to both its shareholders and to society at large. Incentivising the pharmaceutical industry to innovate solely on the grounds of being a socially responsible sector is unlikely to lead to a sustainable and scalable approach for innovating in response to emerging infectious disease threats. There are also potential challenges to the types of innovation (i.e. how radical or incremental) a reliance on incentives rooted solely in a social responsibility argument can lead to. Donating existing compounds for testing is important, but it is different to at-scale, industry-wide intensive investment in R&D geared at developing highly innovative diagnostics, medicines and vaccines. Even in the case of COVID-19, there are significant differences in the scale of innovative activity that focuses on repurposing existing products and technologies – for example, through testing existing antiviral compounds for potential therapeutic value – and more radically innovative R&D efforts aimed at developing something that acts on the COVID-19 virus in fundamentally novel ways.

#### Bioterror causes extinction

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How worthwhile is it spending resources to study and mitigate the chance of human extinction from biological risks? The risks of such a catastrophe are presumably low, so a skeptic might argue that addressing such risks would be a waste of scarce resources. In this article, we investigate this position using a cost-effectiveness approach and ultimately conclude that the expected value of reducing these risks is large, especially since such risks jeopardize the existence of all future human lives. Historically, disease events have been responsible for the greatest death tolls on humanity. The 1918 flu was responsible for more than 50 million deaths,1 while smallpox killed perhaps 10 times that many in the 20th century alone.2 The Black Death was responsible for killing over 25% of the European population,3 while other pandemics, such as the plague of Justinian, are thought to have killed 25 million in the 6th century—constituting over 10% of the world's population at the time.4 It is an open question whether a future pandemic could result in outright human extinction or the irreversible collapse of civilization. A skeptic would have many good reasons to think that existential risk from disease is unlikely. Such a disease would need to spread worldwide to remote populations, overcome rare genetic resistances, and evade detection, cures, and countermeasures. Even evolution itself may work in humanity's favor: Virulence and transmission is often a trade-off, and so evolutionary pressures could push against maximally lethal wild-type pathogens.5,6 While these arguments point to a very small risk of human extinction, they do not rule the possibility out entirely. Although rare, there are recorded instances of species going extinct due to disease—primarily in amphibians, but also in 1 mammalian species of rat on Christmas Island.7,8 There are also historical examples of large human populations being almost entirely wiped out by disease, especially when multiple diseases were simultaneously introduced into a population without immunity. The most striking examples of total population collapse include native American tribes exposed to European diseases, such as the Massachusett (86% loss of population), Quiripi-Unquachog (95% loss of population), and the Western Abenaki (which suffered a staggering 98% loss of population).9 In the modern context, no single disease currently exists that combines the worst-case levels of transmissibility, lethality, resistance to countermeasures, and global reach. But many diseases are proof of principle that each worst-case attribute can be realized independently. For example, some diseases exhibit nearly a 100% case fatality ratio in the absence of treatment, such as rabies or septicemic plague. Other diseases have a track record of spreading to virtually every human community worldwide, such as the 1918 flu,10 and seroprevalence studies indicate that other pathogens, such as chickenpox and HSV-1, can successfully reach over 95% of a population.11,12 Under optimal virulence theory, natural evolution would be an unlikely source for pathogens with the highest possible levels of transmissibility, virulence, and global reach. But advances in biotechnology might allow the creation of diseases that combine such traits. Recent controversy has already emerged over a number of scientific experiments that resulted in viruses with enhanced transmissibility, lethality, and/or the ability to overcome therapeutics.13-17 Other experiments demonstrated that mousepox could be modified to have a 100% case fatality rate and render a vaccine ineffective.18 In addition to transmissibility and lethality, studies have shown that other disease traits, such as incubation time, environmental survival, and available vectors, could be modified as well.19-21 Although these experiments had scientific merit and were not conducted with malicious intent, their implications are still worrying. This is especially true given that there is also a long historical track record of state-run bioweapon research applying cutting-edge science and technology to design agents not previously seen in nature. The Soviet bioweapons program developed agents with traits such as enhanced virulence, resistance to therapies, greater environmental resilience, increased difficulty to diagnose or treat, and which caused unexpected disease presentations and outcomes.22 Delivery capabilities have also been subject to the cutting edge of technical development, with Canadian, US, and UK bioweapon efforts playing a critical role in developing the discipline of aerobiology.23,24 While there is no evidence of state-run bioweapons programs directly attempting to develop or deploy bioweapons that would pose an existential risk, the logic of deterrence and mutually assured destruction could create such incentives in more unstable political environments or following a breakdown of the Biological Weapons Convention.25 The possibility of a war between great powers could also increase the pressure to use such weapons—during the World Wars, bioweapons were used across multiple continents, with Germany targeting animals in WWI,26 and Japan using plague to cause an epidemic in China during WWII.27

#### **Disease alone causes extinction.**

Ord ‘20 [Toby; reporter for the Guardian; 3-6-2020; "Why we need worst-case thinking to prevent pandemics"; Guardian; https://www.theguardian.com/science/2020/mar/06/worst-case-thinking-prevent-pandemics-coronavirus-existential-risk]

The world is in the early stages of what may be the **most deadly pandemic** of the **past 100 years**. In China, thousands of people have already died; large outbreaks have begun in South Korea, Iran and Italy; and the rest of the world is bracing for impact. We do not yet know whether the final toll will be measured in thousands or hundreds of thousands. For all our advances in medicine, humanity remains much **more vulnerable** to pandemics than we would like to believe. To understand our vulnerability, and to determine what steps must be taken to end it, it is useful to ask about the very worst-case scenarios. Just how bad could a pandemic be? In science fiction, we sometimes encounter the idea of a pandemic so severe that it could cause **the end of civilisation,** or even of **humanity itself.** Such a risk to humanity’s entire future is known as an **existential risk.** We can say with certainty that the novel coronavirus, named Covid-19, does not pose such a risk. **But could the next pandemic?** To find out, and to put the current outbreak into greater context, let us turn to the past. In 1347, death came to Europe. It entered through the Crimean town of Caffa, brought by the besieging Mongol army. Fleeing merchants unwittingly carried it back to Italy. From there, it spread to France, Spain and England. Then up as far as Norway and across the rest of Europe – all the way to Moscow. Within six years, the Black Death had taken the continent. Tens of millions fell gravely ill, their bodies succumbing to the disease in different ways. Some bore swollen buboes on their necks, armpits and thighs; some had their flesh turn black from haemorrhaging beneath the skin; some coughed blood from the necrotic inflammation of their throats and lungs. All forms involved fever, exhaustion and an intolerable stench from the material that exuded from the body. There were so many dead that mass graves needed to be dug and, even then, cemeteries ran out of room for the bodies. The Black Death **devastated Europe.** In those six years, between a **quarter and half of all Europeans were killed**. The Middle East was ravaged, too, with the plague killing about **one in three Egyptians and Syrians**. And it may have also laid waste to parts of central Asia, India and China. Due to the scant records of the 14th century, we will never know the true toll, but our best estimates are that somewhere between **5% and 14% of all the world’s people were killed**, in what may have been the **greatest catastrophe** humanity has seen. The Black Death was not the only biological disaster to scar human history. It was not even the only great bubonic plague. In AD541 the plague of Justinian struck the Byzantine empire. Over three years, it **took the lives** of roughly **3% of the world’s people.** When Europeans reached the Americas in 1492, the two populations exposed each other to completely novel diseases. Over thousands of years, each population had built up resistance to their own set of diseases, but were extremely susceptible to the others. The American peoples got by far the worse end of the exchange, through diseases such as measles, influenza and, especially, smallpox. During the next 100 years, a combination of invasion and disease took an immense toll – one whose scale may never be known, due to great uncertainty about the size of the pre-existing population. We can’t rule out the loss of more than 90% of the population of the Americas during that century, though the number could also be much lower. And it is very difficult to tease out how much of this should be attributed to war and occupation, rather than disease. At a rough estimate, as many as 10% of the world’s people may have been killed. Centuries later, the world had become so interconnected that a truly global pandemic was possible. Towards the end of the first world war, a devastating strain of influenza, known as the 1918 flu or Spanish flu, spread to six continents, and even remote Pacific islands. About a third of the world’s population were infected and between 3% and 6% were killed. This death toll outstripped that of the first world war. Yet even events like these fall short of being a threat to humanity’s long-term potential. In the great bubonic plagues we saw civilisation in the affected areas falter, but recover. The regional 25%-50% death rate was not enough to precipitate a continent-wide collapse. It changed the relative fortunes of empires, and may have substantially altered the course of history, but if anything, it gives us reason to believe that human civilisation is likely to make it through future events with similar death rates, even if they were global in scale. The Spanish flu pandemic was remarkable in having very little apparent effect on the world’s development, despite its global reach. It looks as if it was lost in the wake of the first world war, which, despite a smaller death toll, seems to have had a much larger effect on the course of history. The full history of humanity covers at least 200,000 years. While we have scarce records for most of these 2,000 centuries, there is a key lesson we can draw from the sheer length of our past. The chance of human extinction from natural catastrophes of any kind must have been very low for most of this time – or we would not have made it so far. But could these risks have changed? Might the past provide false comfort? Our population now is a **thousand times greater** than it was for most of human history, so there are vastly **more opportunities** for new **human diseases to originate.** And our farming practices have created **vast numbers of animals** living in **unhealthy conditions** within **close proximity to humans**. This increases the risk, as many major diseases originate in animals before crossing over to humans. Examples include HIV (chimpanzees), Ebola (bats), Sars (probably civets or bats) and influenza (usually pigs or birds). We do not yet know where Covid-19 came from, though it is very similar to coronaviruses found in bats and pangolins. Evidence suggests that diseases are crossing over into human populations from animals at an increasing rate. **Modern civilisation** may also make it much easier for a **pandemic to spread**. The higher density of people living together in cities **increases the number of people** each of us may infect. Rapid **long-distance transport** greatly increases the **distance pathogens can spread**, reducing the **degrees of separation** between any two people. Moreover, we are no longer divided into isolated populations as we were for most of the past 10,000 years. Together these effects suggest that we might expect **more new pandemics**, for them to **spread more quickly**, and to reach a **higher percentage** of the **world’s people**. But we have also changed the world in ways that offer protection. We have a healthier population; improved sanitation and hygiene; preventative and curative medicine; and a scientific understanding of disease. Perhaps most importantly, we have public health bodies to facilitate global communication and coordination in the face of new outbreaks. We have seen the benefits of this protection through the dramatic decline of endemic infectious disease over the past century (though we can’t be sure pandemics will obey the same trend). Finally, we have spread to a range of locations and environments unprecedented for any mammalian species. This offers special protection from extinction events, because it requires the pathogen to be able to flourish in a vast range of environments and to reach exceptionally isolated populations such as uncontacted tribes, Antarctic researchers and nuclear submarine crews. It is hard to know whether these combined effects have increased or decreased the existential risk from pandemics. This uncertainty is ultimately bad news: we were previously sitting on a powerful argument that the **risk was tiny**; now **we are not.** We have seen the indirect ways that our actions aid and abet the origination and spread of pandemics. But what about cases where we have a much more direct hand in the process – where we deliberately use, improve or create the pathogens? Our understanding and control of pathogens is very recent. Just 200 years ago, we didn’t even understand the basic cause of pandemics – a leading theory in the west claimed that disease was produced by a kind of gas. In just two centuries, we discovered it was caused by a diverse variety of microscopic agents and we worked out how to grow them in the lab, to breed them for different traits, to sequence their genomes, to implant new genes and to create entire functional viruses from their written code. This progress is continuing at a rapid pace. The past 10 years have seen major qualitative breakthroughs, such as the use of the gene editing tool Crispr to efficiently insert new genetic sequences into a genome, and the use of gene drives to efficiently replace populations of natural organisms in the wild with genetically modified versions. This progress in biotechnology seems unlikely to fizzle out anytime soon: there are no insurmountable challenges looming; no fundamental laws blocking further developments. But it would be optimistic to assume that this uncharted new terrain holds only familiar dangers. To start with, let’s set aside the risks from malicious intent, and consider only the risks that can arise from well-intentioned research. Most **scientific and medical research** poses a negligible risk of harms at the scale we are considering. But there is a small fraction that uses **live pathogens** of kinds that are known to **threaten global harm**. These include the agents that cause the **Spanish flu, smallpox, Sars and H5N1 or avian flu**. And a small part of this research involves **making strains** of these pathogens that pose **even more danger** than the natural types, increasing their **transmissibility**, lethality or resistance to vaccination or treatment. In 2012, a Dutch virologist, Ron Fouchier, published details of an experiment on the recent H5N1 strain of bird flu. This strain was extremely deadly, killing an estimated **60% of humans it infected** – far beyond even the Spanish flu. Yet its inability to pass from human to human had so far **prevented a pandemic**. Fouchier wanted to find out whether (and how) H5N1 could naturally develop this ability. He passed the disease through a series of 10 ferrets, which are commonly used as a model for how influenza affects humans. By the time it passed to the final ferret, his strain of H5N1 had become directly transmissible between mammals. The work caused fierce controversy. Much of this was focused on the information contained in his work. The US National Science Advisory Board for Biosecurity ruled that his paper had to be stripped of some of its technical details before publication, to limit the ability of bad actors to cause a pandemic. And the Dutch government claimed that the research broke EU law on exporting information useful for bioweapons. But it is not the possibility of misuse that concerns me here. Fouchier’s research provides a clear example of well-intentioned scientists enhancing the destructive capabilities of pathogens known to threaten global catastrophe. Of course, such experiments are done in secure labs, with stringent safety standards. It is highly unlikely that in any particular case the enhanced pathogens would escape into the wild. But just how unlikely? Unfortunately, we don’t have good data, due to a lack of transparency about incident and escape rates. This prevents society from making well-informed decisions balancing the risks and benefits of this research, and it limits the ability of labs to learn from each other’s incidents. Security for highly dangerous pathogens has been **deeply flawed**, and remains insufficient. In 2001, Britain was struck by a devastating outbreak of foot-and-mouth disease in livestock. Six million animals were killed in an attempt to halt its spread, and the economic damages totalled £8bn. Then, in 2007, there was another outbreak, which was traced to a lab working on the disease. Foot-and-mouth was considered a **highest-category pathogen**, and required the highest level of biosecurity. Yet the virus escaped from a **badly maintained pipe**, leaking into the **groundwater at the facility**. After an investigation, the **lab’s licence was renewed** – only for **another leak to occur two weeks later.** In my view, this track record of escapes shows that even the **highest biosafety level** (BSL-4) is **insufficient for working on pathogens** that pose a risk of global pandemics on the scale of the Spanish flu or worse. Thirteen years since the last publicly acknowledged outbreak from a **BSL-4 facility** is not good enough. It doesn’t matter whether this is from insufficient standards, inspections, operations or penalties. What matters is the poor track record in the field, made worse by a lack of transparency and accountability. With current BSL-4 labs, an **escape of a pandemic pathogen** is only a **matter of time.**

#### Simulations, empirics, and surging connectivity prove

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\*figures omitted for readability\*

Several epidemics, such as the Black Death and the Spanish flu, have threatened human life throughout history; however, it is unclear if humans will remain safe from the sudden and fast spread of epidemic diseases. Moreover, the transmission characteristics of epidemics remain undiscovered. In this study, we present the results of an epidemic simulation experiment revealing the relationship between epidemic parameters and pandemic risk. To analyze the time-dependent risk and impact of epidemics, we considered two parameters for infectious diseases: the recovery time from infection and the transmission rate of the disease. Based on the epidemic simulation, we identified two important aspects of human safety with regard to the threat of a pandemic. First, humans should be safe if the fatality rate is below 100%. Second, even when the fatality rate is 100%, humans would be safe if the average degree of human social networks is below a threshold value. Nevertheless, certain diseases can potentially infect all nodes in the human social networks, and these diseases cause a pandemic when the average degree is larger than the threshold value. These results indicated that certain infectious diseases lead to human extinction and can be prevented by minimizing human contact.

1. Introduction

The emergence of a pandemic is one of the various scenarios frequently discussed as a human extinction event, and it is listed as one of the global catastrophic risks in studies regarding the future [1,2,3]. In particular, several pandemics, such as the Black Death [4,5], Spanish flu [6], and those caused by smallpox [7], severe acute respiratory syndrome (SARS) [8], and Ebola [9], have affected a large population throughout history. The risk of pandemics increases with an increase in population mobility between cities, nations, and continents, thereby threatening humankind [10,11,12]. It is essential to analyze the epidemic spread in society to minimize the damage from epidemic disasters; however, extinctive epidemic spreading experiments have limitations in real-world situations, as they predict stochastic effects on the spread without considering the structure of human society. Network-based approaches have been proposed to overcome these limitations and perform epidemic spreading simulations by considering the network structure of numerous real-world connections [13,14,15]. These methods use various models of epidemic spreading, such as the susceptible–infectious–susceptible (SIS) [16,17,18], susceptible–infectious–recovered (SIR) [19,20,21], and Watts threshold models [22]. While these methods are mathematically convenient, they are epidemiologically unrealistic for various infections because they require exponentially distributed incubation and infectious periods [23,24,25]. Moreover, previous epidemic studies did not perform quantitative assessment of the pandemic risk depending on the network connectivity in individuals and fatality rate of various diseases [26].

In the present study, we applied an SIR epidemic model to a scale-free network with Monte Carlo simulation to identify the quantitative relationship between infectious diseases and human existence. Our fundamental hypothesis states that when the epidemic spreads to all nodes of the network and the fatality rate is 100%, it can increase the pandemic risk. To address this, we initially constructed a scale-free network to simulate a society. Moreover, for the epidemic spreading simulation, an SIR model was applied to the network to describe the immune state of an individual after infection. From the simulation study, we found that the mean degree of a scale-free network was an essential factor in determining whether epidemics threaten humans. This approach provides important insights into epidemic spreading analysis by investigating the relationship between epidemic and scale-free network parameters. Furthermore, it highlights the necessity of determining information flow during an epidemic.

2. Materials and Methods

We designed an epidemic simulation process to identify the relationship between pandemic risk and network parameters. This study was performed in four steps (Figure 1): (i) generating a scale-free network model to reflect real-world conditions; (ii) applying an SIR model to the scale-free network for epidemic spreading simulations; (iii) adapting the Monte Carlo method to reflect the stochastic process in the node status of the SIR model; and (iv) iteratively performing simulation for every parameter set and analyzing the results. We have provided the source code and sample results of epidemic simulation in Supplementary Materials.

Figure 1. Overview of epidemic simulation process based on the Monte Carlo method. (A) We generated scale-free networks for a fixed population (N = 1,000,000) and various node degrees (k = 2, 5, 7, and 10). (B) Epidemic spreading was simulated by applying a susceptible–infectious–recovered (SIR) model to the scale-free network. We set the epidemic parameters, β and γd. β represents the spreading rate of epidemics, and γd is the reciprocal of γ and reflects the time interval between infection and recovery. Randomly, 0.05% of nodes were initially infected. (C) We adapted the Monte Carlo method to determine the status of the transition from the infection node to immunization node. Repeated simulations were performed until a steady state was achieved. (D) For every parameter set, 10,000 simulations were performed.

2.1. Network Generation Based on a Scale-Free Model

We constructed a network model for the epidemic spreading simulation (Figure 1). The nodes and edges of the network represent people in the society and their physical contacts, respectively. We used a scale-free network model, which follows the preferential attachment property observed in numerous real-world networks, such as social networks, physical systems, and economic networks [27,28,29]. In the scale-free network, when a node is added to the network, its likelihood of connecting to existing nodes increases with an increase in the node’s degree. Hub nodes, which lead to fast and vast spreading of epidemics, exist. Two characteristic parameters, including N and k, affect the form of scale-free networks. The parameter N denotes all nodes in the network. In the real world, N indicates the whole population size. The parameter k is the average degree of the network, which determines the degree of the newly attached node for each step during network generation. Following the characteristics of the network model, we generated scale-free networks representing human contacts for epidemic spread. The scale-free network was generated by the Barabasi–Albert graph distribution, in which the network is constructed from a cycle graph with three vertices, followed by the addition of k edges at each construction step [30]. The k edges are randomly attached to the vertex based on the degree distribution of the vertex. After network generation, we investigated the degree distribution properties of the network (Figure 2). The results indicate that the degree distributions have similar tendency for networks with varying number of nodes and edges. This study constructed scale-free networks with the largest number of nodes considering computational complexity (N = 1,000,000).

Figure 2. Degree distribution of the scale-free network. We analyzed the degree distribution of the network based on the number of nodes (N) and mean degree (k).

2.2. Epidemic Spreading Based on the SIR Model

For the epidemic spreading simulations, we applied an SIR model to the generated scale-free network. The classical SIR model can be expressed by the following nonlinear differential equations [21]:

where S, I, and R represent susceptible, infected, and recovered compartments, respectively, in the whole population. S represents people who have not been infected yet but can be infected in future. I represents infected people who can spread the epidemic to susceptible people through physical contact. R denotes people who have recovered or died from the epidemic and who no longer participate in the epidemic spreading process. The sum of the S, I, and R values represents the whole population size N. Epidemics have two parameters in the SIR model, transmission rate (β) and recovery rate (γ), which arise from the basic reproduction number R0 (Figure 1B). The basic reproduction number is the number of infections caused by one infective node [31,32,33]. If the R0 is more than 1, the infection can spread in a population, whereas if R0 is less than 1, the infection cannot spread. We express the basic reproduction number as R0 = β/γ, where β represents the spreading rate of epidemics between infective nodes and adjacent susceptible nodes and γ represents the probability of recovery from infection [34]. We mainly used γd, which is the reciprocal of γ and reflects the time interval between infection and recovery.

2.3. Investigation of Epidemic Status Based on the Monte Carlo Method

The epidemic simulation was performed for a time series event by constructing epidemic status matrix (z) to represent the status of the nth node at time step t. For each node, the value of epidemic status matrix at time step t can be 0, 1, or 2, indicating that a node is susceptible, infective, or recovered, respectively. We initially (t = 0) set every value of epidemic status matrix to 0 because all nodes are susceptible before the epidemic spreads. At the initial infection stage, randomly selected 0.05% of nodes were infected. At every time period, we performed immunization and observed the infection stages (Figure 3).

At the immunization stage, we identified infective nodes and determined whether these nodes would be recovered in the next time step. To calculate the transition probability of infected and recovered phenomena, the Monte Carlo method was applied [35,36]. When infection and recovery parameters are provided, it is possible to investigate whether a node transitions from an epidemic state to another state. To accomplish this, we compared the method revealing the change in each population in every compartment over time (Figure 4).

The final steady state of the epidemic spreading simulation model indicates the total number of casualties of the epidemic who either are dead or have recovered from the disease. Infective nodes at time t (zn [t] = 1) are transformed to recovered nodes at time t + 1 (zn [t + 1] = 2) when 1/γd is larger than a random real number between 0 and 1. We determined whether the neighbor nodes of the infection node would be infected by identifying susceptible nodes adjacent to the infective nodes at time t (zn [t] = 0, with the adjacent infective node) (Figure 5). When β is larger than a random real number between 0 and 1, a susceptible node becomes an infective node at time t + 1 (zn [t + 1] = 1); this scenario represents epidemic spread. For each time step, we recorded the number of susceptible, infective, and recovered nodes during epidemic spread.

2.4. Simulation Parameters

We carried out simulation trials for various mean degrees of networks (k = 2, 5, 7, and 10). Each network considered the following epidemic parameters: β ranges from 0.05 to 0.95 and γd ranges from 1 to 10. The Monte Carlo model was repeatedly simulated to observe saturation of the recovery process. Considering that the simulation pipeline contains random processes such as initial infection and Monte Carlo trials, we performed the simulation iteratively until the status of nodes remained unchanged. After simulation, time series data from every simulation were interpolated in the time domain.

The fatality rate determines the ratio of deceased and recovered individuals in the final population [37,38,39]. If the fatality rate is below 100%, the recovered population contains both dead and recovered individuals. Such a situation does not always cause a pandemic. In this simulation, we assumed a 100% fatality rate. To accomplish this, we enumerated the recovered nodes as dead for considering the pandemic risk.

3. Results

Through our method, we obtained epidemic spreading data with various network and epidemic parameter sets. In the present study, we focused on the case where the epidemic infects all nodes and defined this phenomenon as “extinctive spread”. Diseases causing extinctive spread are potential candidates of high pandemic risk. In the real world, extinctive spreading indicates that the disease will infect every person in the society. From the simulation data, we calculated the extinctive spread score by dividing the total number of simulation trials by the number of extinctive spread cases. Thereafter, we identified that the number of extinctive spread cases is mainly influenced by spreading speed, which is determined by β, γd, and k (Figure 6).

The extinctive spread region (brown area in Figure 6) is expanded as the value of mean degree of network (k) is increased, thereby indicating that the area of extinctive spread becomes noticeably wider in a dense network than in a sparse network. Thus, the more contact between people, the higher the risk of epidemics. Moreover, high γd and high β cause extinctive spread across a large region, indicating that the high spreading rate and short time interval between infection and recovery are risk factors of epidemic diseases. In contrast, the infective nodes recover before they transmit the disease to their neighbors in low β and low γd scenarios, thus disconnecting the network and preventing extinctive spread. This occurs because the infective nodes need more time to transmit the disease in low β and high γd scenarios. Therefore, the disease begins to subside due to a lack of new infective nodes.

Furthermore, we investigated the range of β and γd for existing epidemics of the common cold [40,41] and fatal diseases, namely, cholera [42,43], Marburg [44,45], Ebola (Congo and Uganda) [46,47,48,49], SARS [50], and MERS [51] (Table 1). We selected diseases with relatively well-known epidemic parameters, such as average duration of infection and basic number of reproductions from previous studies. Transmission rates were calculated using the mean duration of infectious periods and basic reproduction numbers of the epidemics. Different studies reveal multiple values of infectious period and transmission rate for some of these diseases; we considered these values separately [40,41,42,43,46,47,48,49]. For example, the infectious period of a common cold is from 3 to 7 days and that of Ebola is 6.5 days. Next, we placed the possible regions of these epidemics as a disease band for various k values (colored lines in Figure 6). When k > 5, fatal diseases have an opportunity to cause a pandemic. Even when k = 5, diseases such as cholera and Ebola (Congo) can be threatening in regions of low γd and high, thus demonstrating that the knowledge of network parameters of the society and the characteristics of epidemic diseases can aid in quantifying the risk of epidemics.

4. Discussion

Many previous studies have made stochastic SIR models to analyze the dynamics or stability of epidemic diseases. They investigated the distribution of susceptible, infected, and removed populations for specific epidemic disease spreading, such as cholera, SARS, Marburg, and MERS, based on mathematical modelling [52,53,54,55]. However, they did not conduct a quantitative assessment of pandemic risk taking into account physical contact between people. To solve this limitation, we performed epidemic spreading simulations by applying an SIR model to scale-free networks with Monte Carlo simulation. In the simulation, we consider various connectivity and disease characteristics on scale-free networks. For each network and epidemic parameter set, the probability of extinctive spread was calculated. The results revealed that certain infectious diseases can lead to extinction. Moreover, even if the disease band extends over the extinctive spread regions, it does not indicate that human extinction results from the disease, as the fatality rate is below 100%; however, in the case of 100% fatality, the disease can cause a human extinction event. The risk of infectious disease is influenced by the network structure. A dense network has a higher risk of spreading infectious disease than a sparse network, as we observed in the extinctive spreading maps. According to our results, when the average degree of human social networks is below the risk threshold, i.e., less than 4 in this study, human society is safe from an extinctive outbreak based on our knowledge regarding the epidemic parameters of the infectious disease. Nevertheless, in other cases, human extinction is possible. For example, if the population is 1,000,000 and there are 4 or more instances of physical contact between people, human extinction events may occur, depending on the fatality rate of the epidemics. Hence, physical contact between people is closely related to an extinction event of infectious diseases. Eventually, from a public health perspective, lowering the average contact level of society is an appropriate way to increase the robustness of strategies against the occurrence of extinction. In the real world, reducing network density can be accomplished by epidemic prevention activity, such as isolation and quarantine treatment. This action prevents epidemic risk to the society, thereby avoiding human extinction.

Additional considerations may improve our analysis. First, large population size and various proportions of initial infective nodes were not considered in the experiments. We have confirmed that the result was consistent when the proportion of initial infective nodes was 0.05% of the total population; however, this can vary depending on the distinct proportion of initial infective nodes in a different population. To achieve robust results, we need to perform additional experiments for various parameters; however, we could not address this issue due to computational complexity. Second, we did not consider numerous known epidemic diseases. We calculated the transmission rates of epidemic diseases using the known infectious periods and reproduction numbers of the epidemics from evidence in the literature. In the present study, we only considered five epidemic diseases, since the information on infectious periods and reproduction numbers of diseases was mostly unavailable for other epidemic diseases. Third, this study only considers the SIR model on scale-free networks in epidemic simulation. Since the dynamics of epidemic diseases can be varied in different models or networks, it is important to experiment in various simulation environments to confirm the robustness of the results. Nevertheless, these limitations can be considered in future experiments or using improved computational methods. With these further improvements, our approach can be used as a computational tool to analyze the risk of epidemic diseases.

5. Conclusions

In this study, we analyzed the risk of epidemic diseases by creating an epidemic simulation on a scale-free network. Based on the simulation results for various epidemic parameters, we confirmed that certain infectious diseases can lead to extinction and can be prevented by minimizing human contact. We believe that identifying potential candidate diseases that may lead to human extinction is crucial in addressing epidemic prevention activities such as quarantine.

#### Small-molecule antibiotics guarantee ABR AND induce microbiome breakdowns through off-target effects. Biologics are key to solve

Cynthia A. Challener 18, PhD, is a contributing editor to BioPharm International, “Fighting Bacterial Resistance with Biologics,” Pharmaceutical Technology, Vol. 42, No. 12, December 2018, pp 36–37

Antibody-based drugs offer new mechanisms of action and greater specificity.

The rise of antibiotic-resistant bacteria is recognized as a significant threat to the future practice of medicine. Continually rising resistance rates have resulted in infections with bacteria resistant to all existing antibiotic treatment options. There is concern that if the current treatment system remains unchanged, the resistance epidemic could push the world into a post-antibiotic era.

Alternatives are therefore needed to replace current small-molecule antibiotics. Given that the development of resistance is a natural form of evolution for bacteria, the challenge is to find new drugs that kill bacteria in a way that dramatically slows down their ability to counteract them. Biologic drug substances-monoclonal antibodies (mAbs) in particular-may be a key component of the solution.

Resistance is multifaceted

Regardless of the antibiotic, resistance will develop, according to MedImmune’s director of microbial sciences Bret Sellman. “Most available antibiotics are related to natural products for which resistance already exists in nature,” he explains. Bacteria also divide rapidly, which increases the likelihood for antibiotic-resistant mutants to evolve.

In addition, over the past four decades there have been few truly novel antibiotics, according to James Levin, director of preclinical development at Cidara Therapeutics. “We have been targeting the same limited subset of essential proteins, and therefore, bacteria have ample opportunity to evolve and become resistant to entire antibiotic classes over time,” he observes.

Sellman argues that development of antibiotic resistance has less to do with the structure or chemistry of antibiotics than it does their method of attacking a pathogen and their widespread use in modern medicine and farming. “By killing bacteria directly, antibiotics select for the outgrowth of resistant mutants. In addition, the misuse of antibiotics to treat viral diseases (e.g., the common cold) unnecessarily exposes patients and their bacteria to antibiotics and fails to treat the actual disease being experienced. This ease of access only increases exposure and subsequently the risk of resistance,” he asserts.

Resistance can arise from chemical modification of the antibiotic by bacterial enzymes or mutations to the antibiotic target, adds Levin. He also notes that bacteria are able to swap genes that impart antibiotic resistance with other bacteria, allowing resistance to spread rapidly.

Adding to these escape mechanism issues, Levin points out that gram-negative bacteria are intrinsically resistant to many antibiotics because they possess an outer membrane that is impermeable to most drugs-and they can mutate to reduce permeability further when under selective pressure.

The problem with broad-spectrum antibiotics

There is an additional problem associated with the use of broad-spectrum antibiotics: they kill not only harmful pathogens, but “good” bacteria that make up the microbiome within humans. Doing so results in the development of resistance in the target pathogen as well as the members of healthy microbiome, which can then transfer resistance to pathogens they encounter, further spreading the problem, according to Sellman.

Damage to the healthy microbiome can have significant consequences as well. “Killing of the healthy microbiome has been linked not only to the development of Clostridium difficile diarrhea but also diabetes, obesity, immune defects, and antibiotic resistance spread through gene transfer,” he says.

Pathogen-specific strategies

While antibiotics will always play an important role in saving and preserving life, the growing antibiotic resistance epidemic and increasing understanding of the adverse effects of broad-spectrum antibiotics on the healthy microbiome necessitate the development of alternatives such as pathogen-specific strategies to prevent or treat bacterial infections, according to Sellman. “We firmly believe that moving away from traditional small molecules is the path forward in anti-infectives research,” Levin agrees.

Most efforts are focused on new drugs based on mAbs because of their specificity. “Such targeted antibacterials should have reduced toxicity, cause less harm to patients’ beneficial microbiomes, and not promote resistance in bacteria not targeted,” Sellman comments.

Antibacterial mAbs also directly neutralize bacterial virulence mechanisms and engage the patient’s immune system, according to Sellman. “By boosting the immune system to kill the pathogen rather than killing the bacteria directly, the emergence of resistance might be reduced,” he explains.

Cidara Therapeutics is developing antimicrobial antibody-drug conjugates (ADCs). “These bispecific molecules capitalize on the potency of antibiotics coupled with the beneficial aspects of an effective and robust immune response and can be designed with a prolonged half-life,” says Levin. He believes that any antimicrobial, including small molecules, that binds to a surface or cell-wall component of the bacterium is a viable candidate for conjugation to an antibody fragment crystallizable (Fc) region.

In addition to antibody-based drug candidates, Sellman notes that researchers across industry and academia are also exploring phage lysins and viral phage approaches as alternatives to small-molecule antimicrobials.

Antibacterial biologics require new thinking

Development of mAb antimicrobial drugs does not come without challenges, but those difficulties are not solely in the scientific arena. “In order to realize the promise of biologics in infectious disease, we need to evolve the way we plan to manufacture and diagnose for these medicines,” Sellman states. Because antibacterial mAbs would likely be most effective in the earlier stages of infections, a move to integrate mAbs into the mainstream infectious disease protocol would require a commitment to more rapid diagnostic methods.

In addition, he notes that because pathogen-specific mAb treatments must account for bacterial strain diversity and the expression of multiple virulence determinants by the infecting pathogen, mAb combinations may be required for optimal efficacy.

The higher cost of biologic antibiotic drug substances compared to their small-molecule counterparts could also be an issue, according to Levin. His hope is, though, that the significantly longer half-life that should be achievable for biologic antibiotics, including ADCs, will enable less frequent dosing and thus offset the higher cost.

An ADC approach

Cidara Therapeutics set out to develop ADC antibiotics that exert a direct killing effect on the pathogen; engage the immune system, bringing a second mechanism of killing into play; potentiate standard-of-care antibiotics by attacking the bacterial cell wall and allowing them to penetrate the cell more effectively; and have superior (antibody-like) pharmacokinetic and distribution properties.

The company conjugates surface-acting antimicrobials (targeting moieties [TMs]) to Fc regions of human antibodies using non-cleavable linkers. The bispecific Cloudbreak ADCs exert direct killing activity on bacteria while targeting the cell for destruction by the immune system, according to Levin. “We believe that by developing drugs with a dual killing mechanism we will reduce the opportunity for the target pathogen to develop resistance. In addition, since our TMs do not have to reach the inside of the cell to kill the bacterium, we avoid the daunting problem of having to breach the bacterial membrane in gram-negative bacteria,” he says. In addition, because antibodies can remain at effective concentrations in plasma for a month or longer, Cidara believes its ADCs can ultimately be engineered to achieve a similar half-life.

The company recently demonstrated proof of concept with an ADC comprising a peptidic antimicrobial conjugated to a human Fc. “Although not our final drug candidate, this ADC was efficacious in murine Acinetobacter and Pseudomonas pneumonia models. It also demonstrated a much longer half-life than the polypeptide alone,” Levin notes. In-house characterization by Cidara’s immunology team further demonstrated the ability of this conjugate to successfully engage the immune system to enhance bacterial killing. Some of this work was performed in collaboration with Professor Ashraf Ibrahim at UCLA and has yielded important insights into the mechanism of action of ADCs.

The Cloudbreak ADCs are in preclinical development, but Levin expects a clinical candidate to be nominated in 2019. Current efforts are focused on evaluation of lead candidates in preclinical toxicology studies and exploration of Fc modifications to further extend in-vivo half-life. The company received a National Institutes of Health grant in 2018 in conjunction with Professor David Perlin at Rutgers that should accelerate the pace of its ADC program, according to Levin. Cidara is also applying its Cloudbreak technology to the development of antivirals.

Two mAb assets in development

Within MedImmune, the global biologics research and development arm of AstraZeneca, two Phase II mAb assets are in clinical testing. MEDI4893 (suvratoxumab) is under investigation for the prevention of Staphylococcus aureus pneumonia in intensive care unit patients, while MEDI3902 is being developed for the prevention of Pseudomonas aeruginosa pneumonia in intensive care unit patients.

“As we continue to explore this field, we are constantly learning about the critical role of the commensal microbiome in maintaining overall health, and even the role it can play in possibly treating certain diseases. With this understanding comes a commitment to exploring new therapeutic options that avoid damaging these beneficial bacteria. The targeting specificity of biologics offers tremendous promise in making this goal a reality,” Sellman concludes.

#### Biosimilars surge global vaccine access---eliminates supply AND innovation constraints

Sara Eve Crager 18, with the Department of Emergency Medicine, University of California, Los Angeles, “Improving Global Access to New Vaccines: Intellectual Property, Technology Transfer, and Regulatory Pathways,” American Journal of Public Health, vol. 108, no. S6, American Public Health Association, 12/01/2018, pp. S414–S420

The 2012 World Health Assembly Global Vaccine Action Plan called for global access to new vaccines within 5 years of licensure. Current approaches have proven insufficient to achieve sustainable vaccine pricing within such a timeline. Paralleling the successful strategy of generic competition to bring down drug prices, a clear consensus is emerging that market entry of multiple suppliers is a critical factor in expeditiously bringing down prices of new vaccines. In this context, key target objectives for improving access to new vaccines include overcoming intellectual property obstacles, streamlining regulatory pathways for biosimilar vaccines, and reducing market entry timelines for developing-country vaccine manufacturers by transfer of technology and know-how. I propose an intellectual property, technology, and know-how bank as a new approach to facilitate widespread access to new vaccines in low- and middle-income countries by efficient transfer of patented vaccine technologies to multiple developing-country vaccine manufacturers.

Vaccine rollout in low- and middle-income countries (LMICs) routinely lags far behind rollout in high-income countries. As of 2010—a full decade after its introduction—87% of high-income countries included the pneumococcal conjugate vaccine in their immunization schedules, compared with only 2% of low-income countries.1 Although the Haemophilus influenzae type b (Hib) vaccine was being widely used in wealthy countries by the early 1990s, Hib vaccine coverage in Africa was estimated at 24% as of 2006.2 Twenty years after licensure of the hepatitis B vaccine, vaccine coverage was estimated at 90% in the Americas as opposed to only 28% in Southeast Asia, where hepatitis B is endemic.1 These timelines, unfortunately, are the norm rather than the exception for adoption of new vaccines in LMICs. The inequities of this situation are all the more indefensible because the vast majority of mortality from vaccine-preventable diseases occurs in LMICs3; it is estimated that more than 90% of deaths from pneumococcal disease,4 95% of deaths from Hib,5 and 80% of deaths from hepatitis B5 occur in developing countries.

In May 2012, the 65th World Health Assembly endorsed the Global Vaccine Action Plan (GVAP),6 a document that sets ambitious vaccination goals for the upcoming decade. The GVAP reflects the growing recognition by governments, international agencies, and civil society of the importance of vaccines not only for achieving international health priorities but for addressing global issues such as poverty, hunger, education, and gender equality.7 One of the key objectives outlined by the GVAP is for all immunization programs to have sustainable access to universally recommended vaccine technologies within 5 years of licensure. There is an enormous gap between this goal and the current reality of new vaccine rollout in LMICs, and the GVAP recognizes that innovative mechanisms will be needed to support scale-up of new vaccines within the proposed timeline. The Decade of Vaccines collaborative that created the GVAP has proposed the goal of achieving universal vaccine access by 20208; it is estimated that this goal will cost more than US $57 billion, with new vaccines responsible for over half the cost.9

Although there are numerous social and logistical obstacles to the adoption of new vaccines in LMICs, a clear consensus has emerged that one of the greatest barriers is vaccine pricing.10–15 This problem is being compounded by the increasingly high costs associated with recent vaccine innovations. The newly developed human papillomavirus (HPV) vaccine, for example, is the most expensive vaccine in history16; this is particularly problematic because the overwhelming majority of cervical cancer cases occur in developing countries.17 Like many new vaccines, the high cost of the HPV vaccine will be most prohibitive in exactly the places it is most needed, and it is unlikely that expensive new vaccines such as the HPV vaccine will become widely accessible in LMICs without extensive external funding.

Currently, the most important source of external funding for vaccines in low-income countries is the Global Alliance for Vaccines and Immunizations (GAVI). GAVI’s critical role in the introduction of new vaccines to low-income countries, most recently with its commitment to introducing the HPV vaccine,18 cannot be overstated; however, there are significant limitations inherent in this support. First, new vaccine introduction is only 1 component of GAVI’s vaccination programs, and the decision to introduce a new vaccine is based on numerous factors, which inevitably include the price of the vaccine and GAVI’s current financial status. In 2010, GAVI was facing a serious budget shortfall of over $4 billion, which threatened to limit future plans to introduce new vaccines.19 GAVI was able to raise sufficient funds to overcome this budgetary crisis; however, the shortfall highlights concerns regarding the long-term stability of GAVI’s subsidies for the future introduction of new vaccines. In any event, LMICs that are not eligible for GAVI funding are likely to have difficulty financing new vaccines without assistance,12 and the GVAP notes that innovative pricing strategies will be particularly important for those LMICs that do not have access to GAVI pricing and procurement mechanisms. In addition, the subsidies provided by GAVI to finance new vaccines are intended to be limited to a 5-year period, with the expectation that, over that time, prices will fall, allowing donors and national governments to continue vaccine financing. To date, however, this expectation has not been realized. Once it became apparent that vaccine prices were not dropping rapidly enough, GAVI was forced to revise its support timelines. Thus, a critical limitation to GAVI’s role in promoting access to new vaccines is the failure to establish mechanisms ensuring sustainable vaccine pricing once the initial period of support has ended.

There is an emerging consensus that the most important factor in achieving sustainable vaccine pricing is the market entry of developing-country vaccine manufacturers (DCVMs).1,20–23 I propose an intellectual property, technology, and know-how (IPTK) bank as a novel strategy to enable early market entry of multiple DCVMs to facilitate rapid rollout and sustainable pricing of new vaccines in LMICs.

In January 2010, a consultation meeting convened by Médecins Sans Frontières and Oxfam brought together experts from around the world to discuss strategies for improving access to vaccines in LMICs.20 New vaccines were a major focus of this meeting, which included representatives from key players such as the Netherlands Vaccine Institute, the International Vaccine Institute, Third World Network, Program for Appropriate Technology in Health, and the World Health Organization (WHO). The consultation meeting report concluded that although organizations such as the Pan American Health Organization Revolving Fund—which effects reduced prices through bulk procurement systems—are key players in improving vaccine access, such entities have not proven sufficient to ensure affordable prices for new vaccines. The report further noted that success with tiered pricing approaches has been mixed and has not consistently resulted in sustainable prices, particularly for new vaccines. It concluded that future strategies to improve access to new vaccines will need to include (1) streamlining regulatory pathways for biosimilar vaccines, (2) addressing intellectual property barriers, and (3) reducing the barriers and timelines to the entry of multiple new suppliers by transfer of technology and know-how. Before addressing each of these strategies in detail, I will briefly discuss the implications of the fact that vaccines are biologics rather than small-molecule drugs.

Vaccines as Biologics and Implications for Access Strategies

The presence of multiple DCVMs has been identified as a critical factor in generating sustainable vaccine prices. It is now widely recognized that the advent of generic drug production, but more importantly the market entry of multiple generic drug suppliers, is the best mechanism for rapidly achieving dramatic price reductions. The major expansion of HIV/AIDS treatment in LMICs, for example, was made possible through the entry of generic manufacturers in countries such as India and Brazil; with the advent of robust generic competition, prices of first-generation antiretroviral drugs fell by more than 99%, from $10 000 annually per patient in 2000 to less than $70 in 2014. Strategies to improve access to medicines have thus coalesced around the goal of enabling generic production. This has led many of these efforts to focus on patent protection as a key barrier to the availability of affordable generic medicines. A crucial assumption that underlies this strategy is that it is fairly straightforward to reverse engineer a given drug; in concept, the problem is not that generic drug manufacturers would be unable to exactly replicate a drug, it is that they are prohibited from doing so by patent law. Although this is generally the case for small-molecule drugs, this basic assumption does not hold true for biologics, including vaccines.

The majority of medications in common use are small-molecule drugs, which are generally low-molecular-weight organic compounds synthesized by chemists. Biologic drugs, a category that includes vaccines, are generally produced by living cells and are significantly larger and structurally more complex than small-molecule drugs. To successfully reverse engineer a small-molecule drug, it is not necessary to precisely duplicate the manufacturing process in order to guarantee an identical product. In the case of vaccines, however, an identical product is not necessarily guaranteed if an alternative production process is used. The details of the vaccine production process can affect variables such as 3-dimensional structure and posttranslational modifications, which are important determinants of vaccine immunogenicity. Detailed information on vaccine production processes is usually not patented. Instead, this information is protected by trade secret law, under which it is never made publicly available because, unlike patent protection, there is no scheduled expiration after a preset term.24 This perpetual monopoly prevents replication of the production process, thus precluding straightforward duplication of the vaccine.25 Furthermore, because vaccine manufacturing is often highly complex, significant know-how may be required to reproduce a vaccine, necessitating direct input from the original product developer.

In sum, although patent protection remains the major barrier to the production of affordable small-molecule generics, access to trade-secret–protected information and know-how present major additional obstacles to generic production of vaccines. A successful vaccine access strategy that relies on early production by multiple DCVMs will need to address all of these issues.

Streamlining Regulatory Pathways for Biosimilar Vaccines

To bring a generic drug to market, a company must go through an abbreviated approval pathway established by national regulatory agencies such as the US Food and Drug Administration. Because of the high degree of manufacturing complexity and the difficulties inherent in reverse-engineering biologics, no abbreviated approval pathway existed for biologics until very recently. Over the past several years, a number of governments have created new regulatory frameworks for abbreviated approval of generic biologics (referred to as “follow-on biologics” or “biosimilars”). The European Union was the first to establish such guidelines,26 and in 2010 the United States passed the Biologics Price Competition and Innovation Act27 as part of the Affordable Care Act. The WHO has also now published guidelines for the approval of biosimilars28 modeled on EU guidelines, and the Indian Department of Biotechnology recently introduced a similar set of guidelines.29

To date, the debate regarding implementation of abbreviated approval pathways for biosimilars has focused on the category of therapeutic proteins, and implementation has yet to be discussed in the context of vaccines. This is partly because therapeutic proteins are far more lucrative for the pharmaceutical industry; the global market for therapeutic proteins was valued at US $93 billion in 2010 and is predicted to reach more than $140 billion by 2017,30 whereas the global vaccine market is currently valued at a little more than $2 billion.31 It is, however, also partly because of the recognition that there are fundamental differences between vaccines and therapeutic proteins that will require special regulatory consideration.32 It will be important for regulators to consider how abbreviated approval pathways for biosimilars should be implemented specifically in the context of vaccines.

The major safety concern surrounding approval of biosimilars is their potential immunogenicity. Immunogenicity, which refers to the tendency of a drug or vaccine to elicit a response from the body’s immune system, can be either a desirable property (in the case of vaccines) or an undesirable property (in the case of therapeutic proteins). Safety concerns related to biosimilars immunogenicity is best exemplified by the oft-cited example of a minor manufacturing change to a therapeutic protein product that resulted in a number of cases of severe anemia thought to be caused by increased product immunogenicity.33 A similar incident is improbable with vaccines because microbial antigens are far less likely to induce an immune response that cross-reacts with endogenous proteins.

Another key issue in the debate over biosimilars is the extent to which additional clinical trials will be necessary for approval. Here as well, special consideration needs to be taken for vaccines, particularly with regard to the potential use of correlates of protective immunity to define appropriate clinical trial endpoints. Defining a validated correlate of protective immunity could allow clinical trial evaluation of biosimilar vaccines to be accomplished more rapidly and at lower cost than will likely be necessary for most therapeutic proteins.34 A precedent for using correlates of protective immunity in this manner was set during clinical trials of the HPV vaccine; Merck conducted a bridging study to a younger age group (in which the use of cervical intraepithelial neoplasia as an endpoint was infeasible) by comparing antibody responses to those in the older cohort in whom efficacy had been previously established.35 GlaxoSmithKline has used a similar metric in a noninferiority trial of Cervarix after a manufacturing change, using antibody titers as the major trial endpoint.36 The WHO has set similar precedents; for example, convening a series of expert consultations with the objective of establishing antibody reference values related to clinical efficacy outcomes for the pneumococcal vaccine.37

Issues of the safety and efficacy of biosimilar vaccines, however, will ultimately need to be evaluated on a case-by-case basis. Now that various national governments and international agencies are establishing abbreviated approval pathways for biosimilar biologics, approaches to streamlining a pathway for abbreviated approval of biosimilar vaccines should be explored in detail.

Addressing Intellectual Property Barriers

Although patent protection may not be the sole barrier to the production of biosimilar vaccines, it remains a major obstacle. This is especially true in the era of broad enforcement of the World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights,38 which significantly limits the ability of countries like India (the “pharmacy of the developing world”) to produce medications still under patent protection in high-income countries.39

Gardasil, 1 of 2 recently developed vaccines for HPV, provides an example of the complex patent landscape that can be expected to surround new vaccines. To date, 81 US patents for Gardasil have been granted to a total of 18 different organizations.40 Such a morass of intellectual property clearly has the potential to be a significant impediment to any access strategy that relies on the early entry of new suppliers. In addition, intellectual property barriers will likely apply to new formulations of existent vaccines (e.g., noninjectable delivery systems or improved vaccination schedules), a precedent that has been set by the new intranasal influenza vaccine.41 This could become particularly relevant if an organization wished to apply a technology for adapting delivery methods to the manufacture of a new vaccine (e.g., to produce a noninjectable HPV vaccine).

An access strategy that may be particularly relevant to patent-related barriers to generic production of new vaccines is the Medicines Patent Pool (MPP). The MPP,42 established with the support of UNITAID in 2009, aims to enable the affordable production of HIV drugs still under patent protection by obtaining voluntary licenses from patent holders and making these licenses available to generic companies in LMICs. Through the MPP, licenses to all patents required to produce a given end product are provided as a package to multiple generic manufacturers on a nonexclusive basis. These manufacturers must meet quality, safety, and efficacy standards, and must have access to markets that are large enough to achieve economies of scale and generate major price reductions. Royalties will be paid to patent holders, and generic licenses will be for use only in LMICs, thereby avoiding infringement upon the main target markets of brand-name manufacturers. Although the MPP was established only recently, the response of the pharmaceutical industry has been encouraging thus far.43 To date, the MPP has negotiated licenses with the US National Institutes of Health, Gilead Sciences, Bristol-Myers Squibb, Roche, and ViiV Healthcare, and is currently engaged in discussions with a number of other major pharmaceutical companies.

Reducing Timelines to New Supplier Market Entry

A vaccine access strategy that relies on the rapid market entry of multiple DCVMs must address the issue of intellectual property rights12; however, there are multiple additional barriers that must be surmounted to allow generic companies to efficiently and cost-effectively duplicate a vaccine.44 Access to manufacturing process information protected by trade-secret law, as well as access to technology and know-how held by the innovator company, will likely be necessary. A strategy to incentivize companies to disseminate process secrets and know-how to DCVMs would be a major step toward increasing vaccine access in LMICs.45 Such a strategy would require the relevant actors to work together to find a balance between the need to allow DCVMs to produce vaccines for lower-income markets and the need of innovator firms to recover sunk costs from higher-income markets.45 Transfer of technology and know-how to DCVMs has been identified as a key factor allowing affordable vaccines to reach the market rapidly,20 and innovative technology transfer mechanisms could play a central role in improving vaccine accessibility. It is important to note in this context that most technology transfer licenses cover both patents and trade secrets.46

The WHO has recognized the importance of DCVM technology transfer in their response to the recent crisis in global production capacity of the influenza vaccine.47 In 2007, the WHO created a technology transfer hub as a strategy to rapidly increase the number of influenza vaccine producers in LMICs. In this model, a publicly funded institution provides a base to bring together all necessary manufacturing, clinical, and regulatory expertise to create a comprehensive documentation package with corresponding training modules. This package is then transferred to various DCVMs, allowing them to efficiently and cost-effectively reproduce a vaccine.

The technology transfer hub model recognizes the inefficiencies of currently prevalent one-to-one technology transfer involving a single provider and a single recipient, and the WHO’s technology transfer hub has been highly effective in rapidly expanding DCVM influenza vaccine production capacity48; since its inception, it has facilitated the establishment of 14 DCVMs producing pandemic influenza vaccines.49 It is important to take note of not only the large number of DCVMs that are now producing the vaccine, but also the rapidity with which this was achieved. The WHO is expanding on this concept with their Technology Transfer Initiative, a project to create “centers of excellence” capable of transferring other manufacturing processes to multiple recipients.49

Although technology transfer hubs could provide a highly effective avenue for achieving rapid market entry of multiple DCVMs, they have a critical limitation: this model can only be used with vaccines for which no intellectual property barriers exist in both the country hosting the hub and the country receiving the technology. This requirement will effectively preclude using technology transfer hubs to accelerate the market entry of DCVMs for vaccines still under patent protection. Functionally, then, the technology transfer hub model cannot be applied to new vaccines. Unfortunately, this is exactly the situation in which such a model could prove most useful because it is these vaccines that are the most expensive and thus could benefit most from the early market entry of multiple DCVMs.

#### Key to vaccine diplomacy­---extinction

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Unfortunately, beginning around 2015, we started to see unexpected and fundamental changes leading to a new order in which infectious and tropical diseases either emerged or returned. This book focuses on some of the major twenty-first-century forces responsible for this historic reversal, but here is a brief overview of some of the major determinants now driving up both vaccine-preventable diseases and NTDs.

Political Instability. One of the most potent and unanticipated drivers was political instability. Measles was declared eliminated from the Americas in 2016, but in Venezuela, the collapse of the economy interrupted and disabled its health system, allowing measles to come roaring back. However, measles was not the only infection to reemerge. Malaria also became widespread, as did a host of other NTDs transmitted by insects or snails. The so-called Northern Triangle area of El Salvador, Guatemala, and Honduras also suffered because of escalating drug wars and the resulting economic downturns that affected health systems. In the Old World, wars or Islamic State occupation in Syria, Iraq, and Yemen also promoted the return of vaccine-preventable diseases, including measles and polio, while the simultaneous collapse of insect vector control programs promoted an explosion in the number of cases of cutaneous leishmaniasis, a highly disfiguring disease that produces ulcers and permanent and socially stigmatizing scars. A deadly cholera outbreak, one of the largest ever recorded, swept across Yemen. Throughout war-torn Democratic Republic of Congo (DR Congo), Central African Republic, and South Sudan, measles also returned, as did another form of leishmaniasis known as kala-azar, which causes a leukemia-like illness that killed thousands. Ebola caused a new lethal epidemic in DR Congo in 2019, resulting in over 2,000 deaths, and even more fatalities occurred from measles and cholera. The bottom line was that new twenty-first-century wars, conflict, and political unrest were reversing global gains.

Internal Displacement and Human Migrations. Exacerbating war and political instability were the ensuing human migrations. As people fled conflict and political collapse, thousands of refugees poured into neighboring countries and regions to spread disease. Measles became widespread in Brazil, Colombia, and Ecuador, largely reversing the celebrated 2016 achievement of measles elimination in the Western Hemisphere. Populations also began fleeing the drug wars of the Northern Triangle, although this has not yet translated into measles epidemics. However, the disease did reemerge among displaced people in multiple African nations and in the Middle East. The World Health Organization (WHO) issued a global alert on measles and then followed it with a report revealing that approximately 10 million children in 16 countries were not receiving their routine childhood vaccines for measles, pertussis, and tetanus owing to conflict and human displacement [3]. Similarly, leishmaniasis traveled with the Syrian refugees spilling into Jordan, Lebanon, and Turkey, in some cases establishing a foothold in those countries.

Urbanization. Human migrations from conflict and other factors brought people in large numbers into cities in vast and unprecedented numbers. Thousands crowded into urban slums in Caracas (Venezuela), Aleppo (Syria), and Kinshasa (DR Congo). The urban slums of megacities became a dominant theme of a new world order. As populations outstripped infrastructures, diarrheal diseases, including cholera, emerged in the untreated sewage, while respiratory diseases, including measles and other vaccine-preventable infections, emerged in the crowded conditions. Then the coronavirus disease of 2019 (COVID-19) swept across densely populated urban regions of central China, and next Europe and the United States, ultimately causing a destructive pandemic that may trigger a new economic depression. COVID-19 now represents an imminent threat to vulnerable people living in the crowded urban slums of South Asia, the Middle East, Africa, and Latin America.

Anti-science and Nationalism. An equally worrisome social determinant was the new reality of anti-science. The anti-vaccine or anti-vax movement began to take off in the early 2000s, but by 2015, it had become an ugly monster. It emerged as a media empire, with by some accounts more than 400 misinformation websites actively promoted on social media and e-commerce sites. The anti-vax movement weaponized both Facebook and Amazon in their unique ways. Facebook became the major voice of the anti-vaccine movement, while Amazon turned into the greatest promoter of phony, misinformative books and documentaries. Then the movement acquired a political arm that created political action committees (PACs), each working to enact legislation that made it more and more difficult for children to receive access to vaccines. In 2015, a PAC in Texas arose from the Tea Party, a far-right-wing element of the Republican Party [4]. A similar anti-vaccine initiative steeped in the rhetoric of populism arose in Italy. Somehow the anti-vax movement became tied to a new nationalism arising in the United States and Europe. Nationalism itself became a social determinant of disease.

Later in 2017, the leaders of the anti-vax movement began engaging in predatory behaviors to target selected ethnic and religious groups. As vaccination coverage declined among both Somali immigrants in Minnesota and orthodox Jewish communities in New York as a result of specific targeting by the anti-vax movement, terrible measles outbreaks ensued in 2017 and 2019, respectively. Ultimately, measles epidemics became widespread across North America, while Europe suffered a record 80,000 cases in 2018 and 90,000 cases in the first-half of 2019. Despite the great gains from Gavi, measles reestablished a foothold in the United States and Europe. Epidemics also surfaced in Philippines, Samoa, Madagascar, and elsewhere in the developing world, to the point where the WHO declared “vaccine hesitancy” as one of the world’s most pressing global health issues.

Climate Change. The new twenty-first-century determinants of disease also went beyond social ones. Climate change became a dominant force promoting disease. Mosquito-transmitted arbovirus illnesses such as Zika virus infection, chikungunya, and dengue spread across Central and South America and the Caribbean, before entering Texas and Florida in the United States. In southern Europe, West Nile virus infection and other arbovirus illnesses became common; malaria reappeared in Greece and Italy after it had been gone for decades; and schistosomiasis emerged on the island of Corsica. The Middle East experienced unprecedented high temperatures, which often exceeded 50°C, together with periods of severe and prolonged drought, forcing many to abandon their ancient agricultural lands.

However, it was difficult to attribute the appearance or reappearance of these tropical infections unambiguously to climate change. As noted above, in both the Western Hemisphere and southern Europe, human migrations were also widespread, linked to diaspora from Venezuela and the conflict zones of the Middle East and North Africa, respectively. Cities became vast, crowded, and susceptible to infectious disease transmission. If this trend continues, by 2050 the world will be constituted mostly of hot and steamy megacities, each with more than 10 million people. Complicating things further were the sharp economic downturns in many of these cities, especially in Venezuela, Brazil, the Middle East, and parts of southern Europe. COVID-19 furthered these economic declines. In other words, climate change went hand-in-hand with refugee movements, urbanization, and economic collapse. We had no real way to accurately attribute the risk to the individual social and physical determinants that are bringing back global tropical infectious diseases. However, one thing was clear: diseases that we thought we had vanquished through programs of the Millennium Development Goals were now returning.

Science Envoy

My term as US science envoy coincided with the rise in these geopolitical forces and climate change. I focused on evaluating the diseases arising from the conflict zones and then on designing new technologies to prevent these illnesses. As codirector of a nonprofit organization developing vaccines to combat NTDs (Texas Children’s Hospital Center for Vaccine Development), and as someone with expertise in tropical infectious diseases (I am dean of the National School of Tropical Medicine at Baylor College of Medicine), I had a unique perspective on the diseases arising in this part of the world. In time, we redirected some of the activities of our laboratory toward making vaccines to combat some of the leading illnesses. They included vaccines for leishmaniasis, schistosomiasis, and the major coronavirus infections, including Middle East respiratory syndrome (MERS), a highly lethal disease. We were positioned to assist in building capacity for vaccine development and clinical testing across the Middle East. Vaccines are not the only tools needed to fight the emerging and neglected diseases arising out of the conflict zones, but they are perhaps the most efficient and effective at preventing disease. Yet the Middle East and North Africa are highly depleted in terms of vaccine development capacity. At the time I began as US science envoy, these areas possessed few to no vaccine development capabilities. Moreover, the major pharmaceutical vaccine manufacturers had little interest in developing vaccines to combat the neglected and emerging diseases of Syria, Iraq, and Yemen, and at best modest interest in vaccine capacity building. I therefore embarked on a journey in vaccine diplomacy in order to combat the infections arising in the post-2015 new world order, guided by the example of my role model in this endeavor, Dr. Albert Sabin.

2: A Cold War Legacy

I never had the opportunity to meet Dr. Albert Sabin. He passed away in 1993 before I began my association with Sabin Vaccine Institute, a Washington, DC, nonprofit organization that advocates for vaccines and vaccine science. However, for more than 20 years I was connected with the institute. My association began when I was on the Yale faculty (the institute was started by H. R. Shepherd, a businessman based in New Canaan, Connecticut); continued during the 11 years when I was microbiology chair at George Washington University (the institute relocated with me in 2000); and then ended after I had relocated to Houston, Texas.

One of my favorite activities as president of the Sabin Vaccine Institute was visiting Dr. Sabin’s widow, Heloisa. Heloisa lived off New Mexico Avenue in Washington, DC, not far from the campus of American University. She was born in Brazil and worked at Jornal do Brasil, the major newspaper in Rio de Janeiro. By the time Heloisa met Sabin at a reception for him in Brazil, both had been married previously. Shortly after their marriage in 1972, Heloisa moved with him to Israel when he served as president of the renowned Weizmann Institute, before moving to Washington, DC.

Heloisa’s New Mexico Avenue apartment was like a mini-museum to vaccine diplomacy. It featured pictures of Sabin with President Clinton, Pope John Paul II, and Cuba’s Fidel Castro, to name a few. She also had photos of Sabin with Soviet scientists, and on the tables and walls were plaques and remembrances from dozens of countries. Typically, after sitting in her apartment we would go downstairs to have lunch in a restaurant located nearby. We would pass the time talking about Sabin’s life, his fierce determination to vaccinate the world’s children against polio, and the many complexities of working with foreign governments to conduct vaccination campaigns. One story I remember vividly was her account of Sabin’s visit to Brazil in 1980, when he had openly criticized federal and local health officials for their handling of a polio outbreak. Ultimately, his offer to help Brazil mount a national polio campaign was rebuffed, and Sabin returned disappointed to Washington. There were differing accounts of whether the Brazilian officials were too lax or if Sabin was too abrasive; possibly both were true [1]. Sabin was known for his directness, and his unrelenting demand for excellence often made people around him uncomfortable, but Heloisa both adored and revered him. She was petite and beyond charming, and from her pictures I could tell that back in the day, Heloisa and Albert were probably quite the glamorous couple. Heloisa would always refer to him as “my Albert.” On a few occasions, we would visit his gravesite at Arlington National Cemetery, and she would always remind me that one day she would be buried alongside him. Heloisa passed away in 2016 in her late 90s, just before I left the Sabin Vaccine Institute. Currently, the Albert B. Sabin Archives are located at the University of Cincinnati, where he conducted much of his path-breaking work on the oral polio vaccine.

Sabin was a champion of vaccines, but not only because of his important and fundamental research to develop the polio and other vaccines. He was an unofficial polio ambassador, visiting dozens of countries and convincing government leaders at the highest levels about the importance of instituting polio vaccination campaigns. His stature as a vaccine scientist allowed him entry into Cuba during the 1960s and the USSR in the 1950s and 1960s. Those activities in Cuba and the USSR had special meaning for me. Through a program of backchannel diplomacy and scientific collaboration, Sabin worked with Soviet scientists to jointly develop an oral polio vaccine that employed Sabin’s live virus polio strains, which he had first developed at Cincinnati Children’s Hospital. Those virus strains were then produced at an industrial scale in the USSR and tested on millions of Soviet citizens, ultimately leading to the licensure of the vaccine in the early 1960s and the subsequent eradication of polio. These accomplishments are now the gold standard for how scientists of different ideologies can overcome diplomatic tensions or even overt conflict in order to advance science for humanitarian purposes.

Global Health Diplomacy

Each visit with Heloisa reinforced my conviction that vaccine diplomacy could one day hold a special place in modern society. In our post-2015 world, we need vaccine diplomacy more than ever. Global infectious diseases have taken an unexpected turn for the worse. Owing to breakdowns in health infrastructure from war and instability, together with other modern twenty-first-century forces, infectious diseases once thought to be on their way out, or even gone, are now back. The COVID-19 pandemic is testing international relations on an unprecedented level. Solving these and future infectious disease public health crises will require us to integrate the science of tackling global infections with these new social and physical determinants: poverty, war, political instability, human migrations, urbanization, and anti-science. In turn, navigating such troubled waters will require new approaches linking biomedical and social sciences, including political science and foreign policy.

In my two years in the Obama administration as US science envoy, I came to realize that understanding the biomedical science, the vaccinology, was essential but not always sufficient to solve issues related to building vaccine infrastructures across nations. This was especially true in a complicated space like the Middle East, where deep-seated tribal and Sunni-Shia rivalries continuously threw up roadblocks—often in interesting and unexpected ways. It became apparent that building vaccines, expanding vaccine coverage, and tackling NTDs requires integrating new types of knowledge, including skills related to diplomacy. In some ways, this might bear some resemblance to what Sabin achieved in Cuba and the USSR (okay, maybe not Brazil!) in the 1960s, but widening the tent to include both scientists and nonscientists. To achieve this, I suggested a new framework of vaccine diplomacy that connects political science, philosophy, and foreign policy to the most powerful life science technology ever invented—vaccines.

Before describing and defining vaccine diplomacy, I think it is helpful to first provide a broader understanding of how global health in general is linked to international relations and solving disease problems on a large scale [2]. Some might say it began as an early version of quarantine during the 1300s, when laws were implemented to prevent plague originating in Asia Minor from entering Dubrovnik on Croatia’s Adriatic coast—or much later, starting in the 1850s, when international sanitary conferences were held in Europe to prevent cholera, plague, and other pandemic infectious disease threats from spreading [2]. Then, in the early twentieth century, the Office International d’Hygiène Publique was created in Paris, as well as a health organization linked to the League of Nations [3]. In parallel, the nations in the Western Hemisphere also established a Pan American Sanitary Bureau, later named the Pan American Health Organization, which became the regional office of WHO in the Americas. The actual World Health Organization itself was established in the aftermath of World War II, following the formation of the UN. The WHO’s constitution was enacted on April 7, 1948, now designated as World Health Day. Almost twenty years later, the WHO embarked on the eradication of smallpox through a global vaccination campaign.

Global health diplomacy rapidly accelerated after promulgation of the UN’s Millennium Development Goals, first in 2005, with a revised set of International Health Regulations (IHR), and then in 2007, after the ministers of health of seven nations connected global health to foreign policy through an Oslo Ministerial Declaration [2]. IHR, also known as IHR (2005), is an agreement between all WHO member states focused on global health security, especially for the detection and assessment of major public health events and for strengthening disease control efforts at national entry points, such as seaports and airports. A key driver of the IHR (2005) was the 2003 pandemic of severe acute respiratory syndrome (SARS) that resulted in more than 8,000 cases, with roughly 10% mortality [4]. The SARS pandemic also severely affected the economies of Hong Kong and Toronto, Canada, and were a wake-up call for the disruptive power of lethal epidemics. These initiatives were later strengthened in 2019 following the Ebola epidemic in DR Congo and ultimately were called on to respond to COVID-19 the following year. In this context, my former Yale colleague, Ilona Kickbusch, defines global health diplomacy as a system of global governance in health, while Rebecca Katz, a colleague and former student now at Georgetown University, provided an operational definition. She refers to it as a framework to include treaties between nations—such as IHR, or recognized international partnerships with UN international organizations, Gavi, or global partnerships involving the Gates Foundation or other non-state actors [2].

Vaccine Diplomacy

Throughout modern history, vaccines have surpassed all other biotechnologies in terms of their impact on global public health. Because of vaccines, smallpox was eradicated, and polio has been driven to near global elimination, while measles deaths have declined more than 90%, and Haemophilus influenzae type b meningitis is now a disease of the past in the United States and elsewhere.

I define one part of vaccine diplomacy as a subset or specific aspect of global health diplomacy in which large-scale vaccine delivery is employed as a humanitarian intervention, often led by one or more of the UN agencies, most notably Gavi, UNICEF, and WHO, or potentially a nongovernmental development organization [2]. Examples might include emergency cholera or Ebola vaccinations during outbreaks in Africa, measles vaccination campaigns linked to the Venezuelan diaspora in Brazil or Colombia, or polio eradication campaigns in the conflict areas of Afghanistan, Pakistan, or the Middle East. Other aspects of vaccine diplomacy relate to vaccine access during pandemics, such as efforts to ensure equitable delivery of a vaccine to combat influenza, especially during an epidemic or even a pandemic situation.

Another critical element of vaccine diplomacy includes the development or refinement of new vaccines achieved jointly between scientists of at least two nations. Rather than a UN agency or nongovernmental development organization, the actual scientists lead both the vaccine science and diplomacy [2]. It is especially relevant that scientists from nations in opposition or even outright conflict can work in research organizations, or that they are able to work together and engage in collaborations under conditions of political instability or stress. Under this definition, vaccine diplomacy reached its full expression during a 20-year period of the Cold War between the United States and Soviet Union that began around the time of the Sputnik satellite launch and mostly ended in 1977 with the eradication of smallpox [5]. In my role as US science envoy, I worked to resurrect this vaccine science diplomacy while collaborating with scientists from Muslim-majority countries of the Middle East and North Africa [6].

Do vaccines really deserve their own designation for a special type of diplomacy? Yes, I believe so, especially when we consider that between the past century and this one vaccines have saved hundreds of millions of lives [2]. In this sense, the technology of vaccines and their widespread delivery represent our most potent counterforce to war and political instability in modern times. Vaccines represent not only life-saving technologies and unparalleled instruments for reducing human suffering, but they also serve as potent vehicles for promoting international peace and prosperity. They are humankind’s single greatest invention.

A Brief History of Vaccine Diplomacy

The history of vaccine diplomacy traces an interesting narrative parallel to the history of the vaccines themselves. It started with the British physician Edward Jenner, who in the late 1700s developed the first and original smallpox vaccine. Indeed the word vacca, Latin for “cow,” refers to the fact that the attenuated virus used in the vaccine derived from cows infected with the cowpox virus. However, a more recent analysis questions the true origins of the virus that Jenner actually used, which might have been horse pox, or even another virus entirely, designated simply as “vaccinia” [7]. Jenner’s smallpox vaccine had an immediate impact on public health in England, and it was transported across the Atlantic Ocean to America, where Thomas Jefferson himself conducted vaccine trials in and around Virginia. When he commissioned Meriwether Lewis and William Clark for their expedition a year after the Louisiana Purchase in 1803, Jefferson either encouraged or arranged for them to carry the vaccine into the frontier [2]. Back then, smallpox was devastating Native American populations in the Northern Plains, so the vaccine was potentially a gesture of peace or goodwill. Unfortunately, some historians report that the vaccine preparation degraded to a point where it was never actually used.

In Europe, both England and France celebrated and honored Jenner’s achievements despite increasing hostilities between the two nations. In the period following the French Revolution and after Napoleon became military dictator of France in 1799, Britain had become increasingly concerned about his armies expanding across Europe and his efforts to stop European nations from trading with England. Finally, in 1803, Britain declared war on France, beginning with a naval blockade of the country. Historic battles at Austerlitz and Trafalgar ensued. However, Jenner’s reputation and veneration as the first vaccine scientist had grown to such a point that he was asked to write letters (and possibly engage in other activities) mediating the releases or exchanges of prisoners [2]. For example, in a letter to the French National Institute of Health, he asserted that “the sciences are never at war.” In turn, Napoleon (or some say Empress Josephine) declared, “Jenner—we can’t refuse that man anything” [2]. Ultimately, the Napoleonic wars ended with Napoleon’s defeat at Waterloo, the last time France and England went to war.

These vignettes highlight a future paradigm that subsequently held for the next 200 years—namely, (1) the immediate recognition of the impact of a vaccine as a highly valued technology, and (2) the enormous scientific and professional stature of vaccinologists—vaccine scientists and vaccine developers. That is, until the modern-day anti-vaccine movement began to target us beginning in the early 2000s. An elusive third element, although one not as straightforward and tangible, also attaches to vaccines: the potential for vaccines to both prevent diseases arising out of conflict or twenty-first-century forces, and in some cases, to directly address the actual social determinants. For example, Jenner’s vaccine was itself employed as an instrument of peace during the Napoleonic wars, creating a novel thread through modern history. When another renowned Frenchman, Louis Pasteur, developed the next few vaccines in the mid-1800s, he also used his stature to launch a network of Pasteur Institutes across the Francophone world, including North Africa and Southeast Asia, which initially focused on reproducing Pasteur’s method to prepare and deliver the first rabies vaccine. Echoing Jenner’s comments, Pasteur in an 1888 speech at the founding of the Institut Pasteur in Paris remarked that “science has no country, because knowledge belongs to humanity and is the torch which illuminates the world” [2].

The Cold War was a 45-year period of political hostilities between the United States and the Union of Soviet Socialist Republics that began after World War II and divided much of the globe into two major spheres of influence. Ironically, it became the signature period that generated the fullest expression of vaccine diplomacy. Two enemies put aside their animosities in order to collaborate on the development and testing of the oral polio vaccine, which is now leading to its global elimination or eradication. This is an extraordinary story that few people outside the vaccine world know about. The 1957 launch of the Sputnik satellite was a key moment in American history, when the nation feared falling behind the Soviets in mastery of both space and missile technology. It became a dark chapter in US history when—following on the heels of the “red scare” that resulted from the Soviet annexation of eastern Europe, the Berlin blockade, and our proxy war with China in Korea—we became vigilant, even hyper-vigilant, for any signs of Communist presence on our soil.

One might argue that this was not an ideal time to begin a US-Soviet scientific collaboration on vaccines, but that is more or less what occurred. It turned out that the fear of polio exceeded the threat of Communism. The 1952 polio epidemic in America was the worst on record. It killed more than 3,000 people and caused partial or complete paralytic disease in more than 20,000. Increasingly during the 1950s, school-age children and adolescents were polio victims. Parents in cities across America lived in terror of summer polio epidemics.

Polio also raged in the USSR. Between 1954 and 1959, polio was present in all of the Soviet republics and increasing in incidence yearly, with the highest rates in the Baltics [8]. Polio outbreaks also occurred in Moscow and Minsk [9]. In response, Soviet scientists in 1955 established a Poliomyelitis Research Institute in Moscow and appointed Dr. Mikhail Chumakov to head experimental vaccine development. Another key individual was Dr. Anatoly Smorodintsev, the head of the virology department of the Institute of Experimental Medicine of the USSR Academy of Medical Science [8]. With the agreement of both governments, Chumakov and Smorodintsev traveled to the United States in 1956 to visit with Albert Sabin, who had developed a polio vaccine containing three different live, attenuated poliovirus strains administered by mouth.

Sabin was eager to cooperate with the Soviet scientists because by this time the injectable polio vaccine invented by Dr. Jonas Salk, composed of three virus strains that have been inactivated or killed with formalin, was already licensed and widely used in the United States. So not only was there little appetite to replace it with the Sabin vaccine, but there were insufficient numbers of unvaccinated American children available for testing with the oral version [9]. While Dr. Sabin was able to immunize his own family and small numbers of incarcerated young adults at a federal prison located not too far from his Cincinnati Children’s Hospital laboratory, the number of vaccinated volunteers was far too small for his oral vaccine to achieve product licensure in the United States [9].

As an aside, I will mention that I was privileged to meet with Jonas Salk in 1995. Our meeting was held in his office at the Salk Institute, considered by many to be one of the most visually striking research institutes ever built. It was designed by the famed architect Louis Kahn and overlooks a beach on the coast of La Jolla, California, just north of San Diego. At sunset, the light shines through a gap between its two major buildings, providing an unforgettable effect. At that time, I was an assistant professor at Yale, just a few years into beginning my own vaccine laboratory. Dr. Salk was one of the most gracious and welcoming senior scientists of stature I had ever met. He even agreed to help me further the development of our hookworm vaccine. We spent more than an hour together, during which he proudly showed me the paintings he displayed in his office by his wife, Françoise Gilot (and former partner of Pablo Picasso). I remember the exhilaration after leaving our meeting, believing that Dr. Salk could become an important mentor. I was devastated when just a month later my wife, Ann, phoned me at a meeting in the United Kingdom to tell me that he had passed.

To return to the story: Because the Salk vaccine required an injection, there was still a global need for a different type of polio vaccine that could be administered without the use of a needle and therefore trained medical personnel. This was especially important in developing countries of Africa, Asia, and Latin America, where qualified staff were lacking and health systems were depleted. For poor nations in Africa, Asia, and the Americas, the Sabin vaccine checked a number of boxes. It contained live polioviruses that were weakened or “attenuated” to a point where they can no longer cause disease. The advantage is that the Sabin poliovirus vaccine strains can be given orally because they stimulate a child’s immune response by replicating in the gastrointestinal tract. If it worked, a large group of children in a village or town could be lined up and given the Sabin vaccine via liquid drops, or even drops placed on a sugar cube.

Following the 1956 visit by Russian scientists to the United States, our State Department allowed Sabin to make a reciprocal visit in the summer of that year [9], launching an extraordinary international collaboration in which Sabin’s live polio strains were scaled up for production in the USSR and first tested in Soviet children. Sabin provided sufficient amounts of the vaccine to begin immunizing children in both the USSR and Czechoslovakia, as well as seed lots so that the Soviets, under the direction of Dr. Chumakov, could scale up the virus themselves. According to William Swanson, a freelance journalist based in Minneapolis who wrote about this period for Scientific American, Chumakov had to use his Politburo connections to go over the head of the Russian minister of health, who would not authorize clinical testing of the Sabin vaccine [9]. Chumakov was a courageous man, who always put science and the health of the USSR’s children above politics. His son Dr. Konstantin Chumakov, himself an important vaccine scientist at the US Food and Drug Administration, is a colleague who shared with me fond remembrances of his father, who was a great defender of science during a very difficult period both before and immediately after the death of Stalin. Dr. Mikhail Chumakov died just a few years after Sabin passed away in 1993.

Ultimately, toward the end of 1959, the Russians had successfully prepared 10 million doses of the vaccine derived from Sabin’s live polio strains. The Soviets vaccinated millions of children. In 1991, Dorothy Horstmann, one of the founding professors of virology at Yale University (and a former mentor who recruited me to Yale after my residency at the Children’s Service of the Massachusetts General Hospital) wrote about her experience of providing an independent assessment of the subsequent polio clinical trials that began in 1959. In anticipation of those trials, the WHO asked her to assess in detail over a sixweek period the quality control of the polio laboratories and whether the Soviets implemented adequate steps to ensure the safety of the vaccine [8].

She also reported on Chumakov’s travels across the USSR to meet with groups of physicians in order to organize the vaccination campaign. He went on local TV and radio to ask for community cooperation and worked with local newspapers to explain the importance of the vaccination drive [8]. Detailed surveillance surveys followed, which included home visits by healthcare providers to assess whether there were any harmful effects of the vaccine. In the case of a campaign launched in Tashkent, Uzbekistan, during an actual polio epidemic, epidemiologists went to individual homes to determine the public health impact of the vaccine. An estimated 10–15 million Russian children received the oral polio vaccine developed jointly by Sabin on the US side and Chumakov and colleagues on the Soviet side. Ultimately, almost all Soviet citizens under the age of 20, approximately 100 million individuals, received the vaccine. According to Dr. Horstmann, “Its positive assessment contributed to a rebirth of interest in the oral vaccine and paved the way for large field trials in the United States, leading to licensure of oral vaccine in 1961–62” [8].

As a result of global access to the oral polio vaccine, by 2019 the disease has been eliminated from all but three countries—Nigeria, Afghanistan, and Pakistan —where local hostilities and conflict have interfered with efforts by UN agencies and community health workers to reach all of the areas that require vaccine access.

Downstream, the Sabin vaccine will likely be gradually replaced by the Salk vaccine. While it is clearly beneficial to administer an oral vaccine, a distinct disadvantage of the Sabin vaccine is that it is composed of live virus strains, which can undergo mutation. This means that vaccinated children can—although rarely—shed a mutated version of the virus into the community that produces complications similar to the wild-type poliovirus, including paralysis. Therefore, to truly eliminate global polio, it is believed that follow-up vaccinations with the Salk killed vaccine may be required, and the Salk vaccine is gradually being adopted in most countries. I find it ironic that both the Sabin and Salk vaccines were ultimately required to eradicate global polio. The irony stems from the fact that they were bitter rivals. In my Baylor College of Medicine office, I have a reproduction of a photo of Drs. Sabin and Salk seated next to each other at a conference, but what makes it special is the onlooker seated behind them with an expression of astonishment.

Health as a Bridge to Peace

Joint international development and testing of an oral polio vaccine proved to be a powerful force in overcoming Cold War ideologies. It also became one of the most important and successful biotechnologies ever invented—one that is leading to global polio elimination. Now the WHO has taken the humanitarian dimension of the oral polio vaccine a step higher through its Health as a Bridge for Peace program and its Humanitarian Cease-Fires Project [10]. The project brokers cease-fires in war-torn areas of Afghanistan, Iraq, South Sudan, and elsewhere in order to vaccinate children against polio. A product of the Cold War, to this day the polio vaccine remains a potent weapon for waging peace and eliminating disease.

#### Plan: The United States Federal Government should substantially increase prohibitions on anticompetitive business practices by the private sector by at least expanding the scope of its core antitrust laws to presume that biosimilar reverse payment settlements are anticompetitive

#### Case by case *Actavis* analysis is woefully inadequate at combatting pay for delay monopolization efforts in the status quo, only broad overhaul solves

Robin Feldman and Evan Frondorf, 2016, Feldman is the Harry and Lillian Hastings Professor of Law and Director of the Institute for Innovation Law, University of California Hastings College of the Law, Frondorf is a Research Fellow at the Institute for Innovation Law, University of California Hastings College of the Law, “Drug Wars: A New Generation of Generic Pharmaceutical Delay”, University of California, Hastings College of the Law UC Hastings Scholarship Repository, https://repository.uchastings.edu/cgi/viewcontent.cgi?article=2527&context=faculty\_scholarship

The strategic behaviors in the Hatch-Waxman arena are troubling from the perspective of the theoretical underpinnings of both patent and antitrust law. The patent concern traces back to the constitutional provision that frames all of patent law. From the activities that should be free to all and reserved to none, the patent system chooses to dedicate to some, for a limited period of time, the exclusive use of an innovation based on the theory that this exclusion will redound to the benefit of society.315 The bargain, however, is not unlimited. When the patent expires, everyone should be free to engage in those activities, returning to a competitive environment. HatchWaxman is intended to ensure the prompt return to a competitive environment at the end of the patent term, as well as to create incentives to weed out weak patent claims that are improperly keeping competitors out of the particular innovative space. Pharmaceutical company behavior that extends the period in which the company can hold off competition runs contrary to the patent bargain.

The behaviors described in this article also raise antitrust concerns, although those concerns are framed at a slightly different angle.316 As a general matter in antitrust doctrine, big is not bad; it is what you do with your size that matters.317 Thus, brand-name companies that have earned a monopoly in the market with their blockbuster drugs are targets of antitrust concern only when they attempt to extend their monopoly improperly by colluding with competitors or inappropriately suppressing competition. As scholarly works by this author and others have noted, agreements not to compete and activities that abuse the regulatory process to block competitors raise antitrust concerns.318 Thus, when pharmaceutical company behavior improperly delays or impedes the entry of generic competition, that behavior runs contrary to the open, competitive market environment for which antitrust law yearns.

The theoretical concerns translate into tangible damage to society as well. With patents, the legal system chooses to tolerate certain societal losses for the innovation effects that may result. When brand-name companies extend their monopoly power beyond the expiration of the patent, however, there are unanticipated deadweight losses to society in the form of higher prices. Whether Congress has chosen the optimal parameters for the patent system is a separate question. Once those parameters are set, behaviors that cause additional deadweight losses for society are contrary to the system’s incentive structure, and the damage to society should not be tolerated. The Hatch-Waxman manipulations also are damaging to society in the form of activities that are wasteful for companies and institutions alike. Hide-and-seek games that the courts, the FDA, the FTC, and the Patent and Trademark Office are forced to play are wasteful to all. The games are particularly burdensome on the court system, with pharmaceutical litigation over generic competition now joining patent troll litigation as a major component of new patent lawsuit filings.319 Sadly, given the amount of money at stake, the behaviors are likely to continue unless the legal system finds a way to change the incentives or to create sufficient disincentives. This is not to suggest that progress has been negligible. The shift from simple pay-fordelay agreements to side deals and then to micro-obstructions reflects the progress that regulatory agencies have begun to achieve in the courts. In addition, although micro-obstructions can create a valuable delay in competition, they are more difficult to achieve and often less lengthy than pay-fordelay.

Nevertheless, although the form of the behavior may have shifted, the behavior remains. And although changes such as the Supreme Court decision in Actavis and various congressional amendments have been important, by the time the changes are implemented, the market has moved beyond. The question is, what should come next.

The following discussion explores new directions for the legal system in its continuing efforts to alleviate the gamesmanship that the Hatch-Waxman system has wrought. The discussion is not intended to provide a blueprint for legislation or a description of specific doctrinal provisions. Rather, it is an attempt to suggest the contours of how new approaches could be structured, and to generate discussion of a shift in approach.

B. Systems, Simplification, Sunshine, and Standards-Based Doctrines

In addition to the approaches that have been undertaken so far, managing the evolution of the Hatch-Waxman games will require a systems approach. One could use an analogy from the medical field itself.320 Under the old approach to cancer treatment, physicians would attack a tumor by trying to reduce its size or deny substances that seemed to be feeding it. Modern medical research has suggested, however, that cancer treatment can be far more effective when using a systems approach. Specifically, tumors seem to operate in a networked or systems fashion. Cutting off one approach may simply lead the tumor to develop work-around approaches, and the new approaches may be even more dangerous and damaging than the original pathway. Thus, attacking the problem by trying to mitigate it when it emerges may be as outdated an approach for the patenting and approval of medicines as it is for treatments in which those medicines will be involved.321

Taking a systems approach may allow us to move away from what one of the authors has called death by tinkering—a problem endemic throughout the patent system.322 In this problematic approach, legal actors address difficult questions by adjusting the doctrines a little here and a little there without developing a comprehensive logic for the full breadth of the legal area. Eventually, the entire doctrinal base threatens to collapse under its own weight.

One can see a classic example of death by tinkering in the Federal Circuit’s failed attempts to create a workable rule for determining what types of inventions should qualify as patentable subject matter. For years, the court clung to its “machine-or-transformation” test, making ever finer distinctions to try to avoid uncomfortable results. In the end, the test required considerable hand waving, and one had to suspend a certain amount of disbelief to overlook the logical discrepancies.323 After a series of three cases gently encouraging the Federal Circuit to develop a workable test, the Supreme Court eventually gave up and supplied its own test.324

A similar phenomenon plagues the various doctrines related to whether the definition of an invention reaches beyond the state of the art at the time of the invention. Doctrines developed for mechanical inventions, in which one generally understands all aspects of the technology, have led to uncomfortable results for biologic inventions, in which many unknown factors may be at play. For example, when an invention is a doorknob, one generally understands the various parts and their operation. There are no unexplained pieces and no hints that the door frame may be integrating with the door in ways no one has dreamed.325 Such is not the case with biotechnology inventions, however, and in that realm, society grants rights in the face of significant unknowns.

Doctrinal rules that fit comfortably with mechanical inventions can lead to uncomfortable results in life science cases. Struggling with the problem, different Federal Circuit panels have created doctrinal rules that contradict each other and point in different theoretical directions.326 The rules reach what seem to be good results in each case, but at the expense of doctrinal coherence and the ability to predict the boundaries of patents going forward. The entire area now threatens to collapse. Doctrines related to defining an invention for purposes of comparing it to later inventions are clashing against doctrines related to defining the invention for purposes of comparing it to earlier inventions. Unless one is happy holding up a piece of fruit and declaring that looking in one direction, it is an apple, and looking in another direction, it is an orange, the doctrines are untenable.327

Therefore, the first step in a systems approach would involve focusing on the extent to which different systems interact in the process. These include not only the patent approval system, but also the patent litigation system,328 FDA approval systems—including the Orange Book, REMS, citizens petitions, and other FDA processes—and antitrust doctrines as they may apply to this arena. Effective progress will require working with all of these systems at the same time, lest adjustments to one area lead to counteraction in another. With thirty years of Hatch-Waxman experience, it is time to consider a comprehensive overhaul of the system for generic approval, one that looks more broadly at the interaction of all of the systems.

The second step is to ruthlessly simplify. For those who value complexity, the Hatch-Waxman system is a garden of delights. Complexity breeds opportunity, however, and, in the case of Hatch-Waxman, the Act’s complexity has spawned opportunities for manipulation. An overhaul of the Hatch-Waxman system that resulted in equivalent or even greater complexity would serve little purpose, other than as a full employment act for lawyers. In contrast, a simplified, slimmed-down system would provide fewer opportunities for clever gamesmanship.

From this perspective, the 2009 Biologics Price Competition and Innovation Act (“BPCIA,” also commonly known as the “Biologics Act”) is not encouraging. The legislation was intended to provide a pathway for swift approval of biosimilars, or what could be called generic biologic drugs, in the same way that Hatch-Waxman provided a speedier pathway for ordinary generic drugs. Biologics are complex cell-derived drugs that include antibodies that fight autoimmune diseases and proteins that boost white blood cell counts during chemotherapy. The Biologics Act, however, is even more complex and convoluted than Hatch-Waxman and seems designed on entirely the wrong template.329 It took until September 2015—six years after the act’s passage—for the first biosimilar to reach the market.330 Simplification is not the instinct of lawyers in general nor of patent lawyers in particular. Lawyers are trained to see the nuances in any circumstance and may wish to keep options open for whatever their clients need. Moreover, the patent bar has never been accused of an attraction to exorbitant simplicity. Overcoming these instincts, which are deeply imbedded in the habits of patent stakeholders, will be an essential component of designing a more effective system.

The third step is to let the sun shine in. Both markets and regulators work best when information is fully available—information that invites competition where competition is needed and exposes behavior that regulators can challenge. Moreover, in a world of instant communication, information plays a powerful role in disciplining behavior. Information in pharmaceutical deals and pricing is increasingly segmented, however, and hidden from key players in the industry—whether those players are competitors, regulators, or consumers.

In particular, pharmaceutical pricing is not necessarily drug-specific anymore. Rather, pharmaceutical benefit managers, known as “PBMs,” negotiate the prices for the vast majority of commercially insured drug purchases.331 In other words, PBMs are third-party intermediaries that negotiate drug prices between payers and others. This frequently results in bundled drug pricing, tucked into which may be pricing that reaps supracompetitive rewards or blocks generic competition. For example, a drug company could offer attractive discounts on one drug in exchange for pricing or listing practices that block competition where prices are elevated or competition would be a greater threat.

None of this information is available, either to the market or to regulators. The pharmaceutical ecosystem would benefit tremendously from sunshine rules that require disclosure of PBM pricing deals and rebates. This is not to suggest regulation of pricing, but rather to provide the information that markets and regulators need for efficient functioning.

A fourth step would be to move away from the Supreme Court’s rule of reason analysis for pharmaceutical deals that involve generics. Despite the opening that the Supreme Court created in Actavis, the lower courts largely have been unable or unwilling to walk through it. The burden remains too great for anyone to bear. Rather, with deals involving generic entry, Congress should place the burden on those making the deals to show that they are proper.332 The taint of anticompetitive behavior is too strong throughout these arrangements, and the extent to which these deals undermine HatchWaxman’s intent to introduce generics early and often is too great. One who creates complexity, and the resultant capacity to hide behind that complexity, should have the burden to demonstrate that the effects are justifiable. The most important step, however, is to make more liberal use of standards-based legal doctrines. The Hatch-Waxman system and its various amendments have tended to focus on precise and particularized legal rules. Brand-name drug companies are forbidden from receiving more than one thirty-month stay; the FDA must take final action on a citizen petition in 150 days.

Some fixes have leaned toward the standards approach. For example, the FDA’s ability to deny a citizen petition at any time if it believes a petition was “submitted with the primary purpose of delaying the approval of an application” is an excellent standards-based approach. The amendment granting that power, however, goes on to require that the “petition does not on its face raise valid scientific or regulatory issues,”333 a provision that moves back toward the realm of rule-based approaches. A classic standards-based approach can be found in the tax code’s step transaction doctrine. The doctrine allows tax authorities to collapse all the steps of a transaction together if the authority deems that they are part of an overall plan by the taxpayer.334 The doctrine is aimed at ensuring that taxpayers may not avoid legal restrictions by taking individual steps or a circuitous route.335 A more liberal use of this type of standards-based approach could give courts and regulators the latitude to shut down strategic behavior, as opposed to playing cat and mouse across the regulatory provisions.

#### Only federal action solves, state and local solutions are preempted on pro-competition grounds

Samp 14, Richard A. Samp, Chief Counsel of the Washington Legal Foundation, The Role of State Antitrust Law in the Aftermath of Actavis, 15 MINN. J.L. SCI. & TECH. 149 (2014).

Those holdings suggest some limits on the extent to which states should be permitted to impose antitrust liability on companies that enter into reverse payment drug patent settlements. In particular, any state-law liability is preempted to the extent that it would upset the balance between federal antitrust law and patent law established by Actavis because such liability would “stand[ ] as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress.”73

V. ACTAVIS’S PREEMPTIVE EFFECT

Application of state antitrust law to reverse payment settlements is not merely a hypothetical possibility. There are a fair number of pending lawsuits that challenge reverse payment settlements on state-law grounds. The California Supreme Court has agreed to review one such suit.74 In seeking affirmance of the appeals court’s dismissal of the suit, the defendants argue inter alia that the suit is preempted by federal law.75

As noted above, there is precedent for a finding that state antitrust law is preempted to the extent that it conflicts with the policy underlying a federal statute.76 Moreover, in the context of patent law, federal courts have not hesitated to preempt state laws that the courts deem to stand as an obstacle to accomplishing Congress’s objectives (i.e., encouraging efforts to develop new and useful products).77 To the extent that any portions of Actavis’s holding can be deemed to reflect the Court’s perception of Congress’s new-product development objectives, a state law is preempted if it is inconsistent with that holding and seeks to impose a greater degree of antitrust liability on the parties to a reverse payment settlement.

Actavis’s treatment of settlements involving a compromise entry date appears to meet that description. Actavis held that federal antitrust liability could not arise from a settlement in which the generic manufacturer agrees not compete for a number of years and in return is rewarded with an exclusive license to market its product several years in advance of the patent’s expiration date.78 Accordingly, states are not permitted to impose antitrust liability under similar circumstances because doing so would upset the balance that, according to Actavis, Congress sought to achieve between antitrust and patent law.

Other issues left open by Actavis are likely to be answered in the years ahead. For example, the Supreme Court did not specify whether noncash benefits received by a generic manufacturer in connection with a patent settlement can ever serve as the basis for federal antitrust liability. If the Supreme Court eventually answers that question by stating: “No, federal antitrust law will not examine settlement benefits other than cash that flow to the infringing party,” then it is likely that state antitrust law would be required to conform to that rule. The potential grounds for such a ruling (a desire both to promote settlement of patent disputes and to uphold reliance interests in existing patents) are based largely on values embedded in federal patent law.

There is little reason to believe, however, that the Court would prevent application of state antitrust law to patent settlement agreements where state law is fully consistent with federal antitrust law. Even in areas subject to extensive federal regulation, the Supreme Court has upheld the authority of states to engage in parallel regulation that is not inconsistent with the federal regulation.79 Unless the Court were to determine, as in Connell,80 that states could not be trusted to properly accommodate the objectives of the federal statute at issue (here, federal patent law), there is no reason to conclude that Congress would not have wanted states to be permitted to police the same sorts of anticompetitive conduct that is policed by federal antitrust law. Moreover, states are likely free to impose greater penalties on the proscribed conduct than is available under federal law. As the Court explained in California v. ARC America Corp., state antitrust law is not required to adhere to the same set of sanctions imposed by federal antitrust law.81

It seems reasonably clear, however, that Actavis prohibits states from adopting the procedural devices rejected by the U.S. Supreme Court—either a per se condemnation of reverse payment settlements or a presumption of illegality accompanied by “quick look” review. The Supreme Court rejected those approaches because it determined that in many cases there might well be pro-competitive economic justifications for reverse payment settlements and that presuming their illegality could result in the suppression of economically useful conduct.82 State antitrust laws that adopted the FTC’s proposed presumption of illegality would be subject to similar criticism, and thus would likely be impliedly preempted as inconsistent with the careful balance between antitrust and patent law established by Actavis

#### Circuit splits on *how* Actavis is applied now, but the aff makes antitrust predictable

Kevin Noonan, June 12, 2017, Kevin E. Noonan is a partner with McDonnell Boehnen Hulbert & Berghoff LLP and serves as Chair of the firm’s Biotechnology & Pharmaceuticals Practice Group. An experienced biotechnology patent lawyer, Dr. Noonan brings more than 20 years of extensive work as a molecular biologist studying high-technology problem “The Effects of the Actavis Decision on Reverse Payment Settlement Agreements in ANDA cases -- Four Years After”, JDSUPRA, https://www.jdsupra.com/legalnews/the-effects-of-the-actavis-decision-on-70263/

However, these instructions left much of the work of deciding the quantum of evidence and scope of proof necessary for a court to make an antitrust determination to the lower courts. The value and extent of the majority's teachings on this question drew the Chief Justice's disdain in dissent, wherein he wrote "[g]ood luck to the district courts that must, when faced with a patent settlement, weigh the 'likely anticompetitive effects, redeeming virtues, market power, and potentially offsetting legal considerations present in the circumstances.'"

With this as background, it is instructive to review how the district courts and some appellate courts have grappled with the task given them (over the Chief Justice's misgivings) by the Actavis majority. Generally (and in anticipation of the Supreme Court's decision), settlements were crafted to avoid bald reverse payments in favor of non-monetary considerations. These include terms of such agreements where the branded company agreed not to produce an "authorized generic" version of a branded drug, or entering into supply agreements with the generic drug maker for active pharmaceutical ingredient (API) manufacturing, or licensing other, unrelated patents. These gambits yielded variable results for various challenges, either by the FTC or by consumer complaints (often brought by wholesale or resale pharmacies or other drug suppliers, or unions or other benefits providers.

The FTC has provided consolidated evidence and reports on these results; overall the number of ANDA settlements containing reverse payment terms has decreased by about 50% since the Actavis decision, with the trend being more prevalent for first ANDA filers. There has also been a reduction in the number of settlements involving first filers containing agreements by the branded drug maker not to market an "authorized generic" in competition with the generic entrant. The FTC Report reveals that 81-87% of ANDA litigation settlement agreements filed in FY 2014 did not contain any compensation from the branded to the generic company and/or restrictions on generic market entry.

In the courts, there is general recognition that both "extreme" positions were rejected by the Supreme Court; the patent grant does not give blanket immunity to antitrust liability, but the existence of the agreement does not presume liability either. In applying the "rule of reason," courts have come to different conclusions and used different standards (resulting in the unpredictability the Chief Justice foresaw). One of the first questions addressed has been whether the Court's decision limits antitrust scrutiny to those agreements containing payments of money. One case that addressed this question was In re Lipitor Antitrust Litigation (D. N.J. Sept. 12, 2014), where the District Court ruled that the Actavis standard is not limited to money settlements. A "payment," according to the Court, could be anything having value, but even though settlement agreements not having monetary terms (classic "reverse payments") can satisfy the Actavis standard, plaintiffs must plead sufficient facts to establish the economic value of what a generic drug maker receives:

[W]here Plaintiffs rely on a non-monetary reverse payment of an inchoate claim, they must plead plausible facts including an estimate the monetary value of same so the Actavis rationale can be applied. . . . To meet this standard, Plaintiffs must stand in the shoes of the underlying parties at the time of the settlement, and determine an estimate of the monetary value of the settlement at that time.

In the Lipitor case the District Court dismissed on the pleadings; the mere existence of a settlement is not enough, according to the opinion, a plaintiff must plead sufficient facts to establish the economic value of what the generic drug maker received, so that benefit could be used according to the Supreme Court's Actavis scheme for applying the rule of reason to the parties' activities. In this regard, the developing consensus for bringing an antitrust case puts on the plaintiff the burden of showing an agreement falls within the scope of Supreme Court's factors that indicate a court should perform a "rule of reason" antitrust assessment, which then shifts the burden to the defendant (or, more typically, defendants) to show the pro-competitive features of the agreement. The ultimate burden of establishing an antitrust violation always remains on the plaintiff.

For its part, the FTC has continued to mount antitrust challenges to settlement agreements in ANDA litigation, with varying results. When successful, however, the penalties can be chilling: for example, in two recent cases (In re: Opana ER Antitrust Litigation (MDL) (N.D. Ill. 2017); In re: Lidoderm Antitrust Litigation (N.D. Cal. 2017)) the Commission required antitrust defendants to abstain from settlements containing no-authorized generic and other terms for 10 years. In another recent case, Teva was forced to disgorge $1.2 billion received as the result of settlement (Federal Trade Commission v. Cephalon Inc. (E.D. Pa 2016)).

#### The AFF’s extension of *Actavis* enables a realistic compromise between patent and antitrust law. Otherwise, chaos at the intersection is inevitable.

Daryl Lim 14, Professor of Law and the Director of the Center for Intellectual Property (IP), Information & Privacy Law at the University of Illinois Chicago, “Reverse Payments: Life after Actavis,” Volume 45, Issue 1 Int’l. Rev. Int. Prop. & Competition L.(IIC) 1 (2014), https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=2360795

Beyond reverse payments, Actavis provides a rare and precious opportunity to move the dialogue on the interface between the patent and antitrust laws beyond mere platitudes. Most patent and antitrust stakeholders agree that both regimes seek to promote competition and innovation. An enduring disagreement remains, however, as to how these goals should be operationalized. The fierce rift between the majority and dissent vividly illustrates this: should we give primacy to visible marketplace rivalry or allow more latitude for private ordering between the settling parties?

Some, like the Court, see patent rights defined by both patent and antitrust policies. Thus a patent’s scope, as defined by its claims, the 20-year monopoly over its invention, and dynamic efficiency benefits of exclusion, must be considered together with the impact that the patent owner’s activities have on market competition and consumer welfare. This qualified view of patents echoes its earlier decision in eBay v. MercExchange, where it held that patents do not confer an automatic right to exclude but instead needs to be considered in the context of broader concerns and the equities of the parties.

Moving beyond the “scope of the patent” test could also invite a reexamination of the patent misuse doctrine. A patent law defense created to prevent the abuse of patent rights, its application rests squarely on the “scope of the patent” formulation. Concern over its vagueness and breadth led to it being cabined in part by Congress, but mostly shackled by jurisprudence from the Court of Appeals for the Federal Circuit. A measured revitalization may bring relief to antitrust defendants. Courts, wary of the treble damages and private litigation under antitrust laws, may prefer a more graduated response of temporary unenforceability under patent misuse.

Actavis also invites judges to develop a more sophisticated view of unilateral and concerted conduct by patent owners. Jurisprudence at the interface between the patent and antitrust laws is muddled and outdated. It is a product of schizophrenic pivoting between condemnation of and deference to patents, and a mutual distrust between patent and antitrust stakeholders. Skeptics like Chief Justice Roberts are rightly concerned that greater antitrust intervention could hurt rather than encourage innovation and competition. But it need not be necessarily so.

According to Michael Carrier, co-author of an amicus brief signed by 118 law, economics and business professors, “Actavis promises to be one of the most important patent/antitrust rulings of all time.” He is correct in at least two ways. Described by Robin Feldman as “ground zero” for pharmaceutical development and sales, the impact of Actavis on drug prices and innovation will be felt in the United States and far beyond. In addition to a closer scrutiny of the settlements themselves, Actavis may spur legislative change to allow subsequent generic filers to continue the challenge if the first filer settles. But if that were all Actavis changed, it would still be business as usual, with regional circuit courts going their separate ways and stakeholders speaking over each other.

The true legacy of Actavis lies in the promise of catalyzing those from the patent and antitrust spheres into moving towards a realistic compromise on how the rules that affect them both should look like and function. Writing about Actavis, Shubha Ghosh lamented that “[w]hat keeps the opinion from perhaps being a great one there was [that there was] no consideration of the competing policies with an attempt to reconcile them. While the dissent takes for granted the opposing policies of patent and antitrust, the majority states that this tension is an assumption rather than a reasoned conclusion.”

Through debate, experimentation and refinement innate in the common law, future cases can craft pieces that will form a coherent analytical framework for the interface between the patent and antitrust laws. The effort must be supported by constituents clear-headed enough to look beyond traditional prejudices, who are able to translate economic insights into workable legal rules, and who recognize that failure would mean that law at the interface will look a lot like the current state of American politics – divided, dysfunctional and a hotbed for empty rhetoric.

# 2AC

## 2AC – T EtS

#### 1. W/M: Plan text in a vacuum – only non-arbitrary standard to evaluate T, everything else mixes burdens and means the aff always loses - DA links and competition standards are not given—you need to win them. Using T to guarantee links/competition rigs the game in favor of the negative

#### 2. W/M: The plan presumes illegality for all reverse payments which are currently exempt from antitrust immunity – that’s an expansion of scope

#### Courts are currently split on whether reverse payments violate the Sherman Act

ABA 11 (The American Bar Association, founded August 21, 1878, is a voluntary bar association of lawyers and law students, which is not specific to any jurisdiction in the United States., 1-31-2011, accessed on 7-23-2021, American Bar, ""Pay-for-Delay" Settlements: Antitrust Violation or Proper Exercise of Pharmaceutical Patent Rights?", https://www.americanbar.org/groups/business\_law/publications/blt/2011/01/02\_hanks/)

A Circuit Split Emerges

The increasing popularity of reverse payment settlements in recent years has given rise to a split among the United States Circuit Courts of Appeals on the question of whether and to what extent reverse payment settlements are lawful. Although it has had numerous opportunities (including a current pending petition for certiorari), the Supreme Court has yet to decide whether reverse payment settlements are enforceable, or if they violate the Sherman Antitrust Act.

The Sixth Circuit--Per Se Illegal Restraints

In In re Cardizem CD Antitrust Litig., 332 F.3d 896, 914-15 (6th Cir. 2003), the Sixth Circuit adopted the FTC's view and held that a reverse payment settlements are per se violations of section 1 of the Sherman Antitrust Act. Defendant Hoechst Marion Roussel (HMR), a brand-name manufacturer, produced Cardizem CD. Andrx was the first to file an ANDA with a Paragraph IV certification seeking approval to market a generic Cardizem product, entitling it to the 180-day exclusivity period once it received FDA approval. After HMR sued Andrx for patent infringement (and while the litigation was pending), HMR and Andrx entered into an agreement whereby HMR would make quarterly payments of $10 million to Andrx. In exchange, Andrx agreed to stay out of the market until either: (1) there was a final decision in the patent infringement case allowing Andrx to market the pharmaceutical; (2) HMR and Andrx entered into a license agreement; or (3) HMR entered into a license agreement with a third party. Andrx also agreed not to "relinquish or otherwise compromise" its 180-day exclusivity period.

The Sixth Circuit held that the agreement was "an illegal per se restraint on trade" under the Sherman Antitrust Act because it was "a horizontal agreement to eliminate competition." In finding the agreement per se illegal, the Sixth Circuit was particularly troubled by the fact that HMR's agreement with Andrx effectively used the 180-day exclusivity period to delay the entry of other generic competitors. In this regard, the court noted: "By delaying Andrx's entry into the market, the Agreement also delayed the entry of other generic competitors, who could not enter until the expiration of Andrx's 180-day period of marketing exclusivity, which Andrx had agreed not to relinquish or transfer."

As of the date of this writing, no other appellate court or district court has followed the Sixth Circuit in holding that reverse payment settlements are a per se illegal restraint on trade.

#### 3. C/I Scope means the range of what is covered.

Cambridge Dictionary ND. "scope". https://dictionary.cambridge.org/us/dictionary/english/scope

scope noun [U] (RANGE)

C1

the range of a subject covered by a book, program, discussion, class, etc.:

1. I'm afraid that problem is beyond/outside the scope of my lecture.
2. Oil painting does not come within the scope of a class of this kind.
3. We would now like to broaden/widen the scope of the discussion and look at more general matters.

#### ‘Expand’ means increase in size.

Macmillan Dictionary – (Macmillan Dictionary, English Language Dictionary; “expand,” doa: 7-29-2021) url: https://www.macmillandictionary.com/us/dictionary/american/expand

expand ​‌‌VERB US /ɪkˈspænd/

WORD FORMS + DEFINITION

1. increase in size

2. increase business

3. add more details

4. spread

5. write in longer form

#### Prefer it:

#### Overlimiting – changing the nature of which practices are considered exempt from antitrust scrutiny is the core of the topic. Those affs are necessary to have aff innovation and a chance of winning

#### Functional limits – states CP, antitrust PIC, advantage CPs, and innovation and tradeoff DAs cover up any holes in neg research

#### Reasonability— Competing interps creates a race to the bottom which makes being aff impossible. Default to ordinary meaning

US Legal No Date “Ordinary-Meaning Rule Law and Legal Definition, US Legal, https://definitions.uslegal.com/o/ordinary-meaning-rule/

Ordinary meaning rule is a principle of statutory interpretation that when a word is not defined in a statute or other legal instrument, the court normally construes it in accordance with its ordinary or natural meaning. This rule guides courts faced with litigation that turns on the meaning of a term not defined by the statute, or on that of a word found within a definition itself.

According to this rule, statutes are to be interpreted using the ordinary meaning of the language of the statute unless a statute explicitly defines some of its terms otherwise. However, if the words are clear, they must be applied, even though the intention of the legislator may have been different or the result is harsh or undesirable.

## 2AC – Single Payer CP

#### b. discourages capital investments---kills innovation

Capretta 16 (James, a resident fellow and holds the Milton Friedman Chair at the American Enterprise Institute, where he studies health care, entitlement, and US budgetary policy “Healthcare reform” <http://www.aei.org/publication/healthcare-reform/>)

Placing all decision-making with the central government is not without its own problems, of course. There is great variation around the world in the quality of medical services provided by government-controlled systems, but a common problem is a severe lack of capital investment and the imposition of price controls to artificially lower the cost of care. When prices are held below what would occur in a less regulated marketplace, supply is always and everywhere restricted, which is why patients in many countries often must wait many weeks or months for certain services.

Health systems run by central governments are also less flexible and open to innovation. If the U.S. were to adopt fully a government-run model, that would likely discourage companies from making the expensive investments needed to develop and test the next generation of drugs and other products that might help patients.

#### c. regulatory uncertainty---dries up investment in medical innovation **Erixon 16**

(Fredrik Erixon, Director for the European Centre for International Political Economy, a global economy think tank, he graduated from University of Oxford, London School of Economics, and Bjorn Weigel, on the board for the ECIPE, “Risk, Regulation, and the Innovation Slowdown” https://www.cato.org/policy-report/septemberoctober-2016/risk-regulation-innovation-slowdown)

Economic regulation reduces the scope for innovators and entrepreneurs to experiment and contest markets. Yet perhaps even more detrimental to innovation has been the rise of social regulations (e.g. environment, consumer, and health protection) and how they increasingly interfere with potential innovation. Product regulations in areas like medicine and medical devices have not just raised the cost of innovation, but created uncertainty about the chances of new innovations to be approved by authorities. Such uncertainty is toxic for company managers — and especially managers with owners who demand a high degree of predictability. Consider the use of the “precautionary principle” in European legislation. It is used for many different purposes, but no one knows what it really entails for regulation. A classic example is how it has destroyed the ambitions of biotechnological firms to innovate in the field of genetically modified organisms: both approvals and rejections of a genetically modified crop cite the precautionary principle. Another example is how chemical firms have reduced their innovation investments because they have spent a decade conforming to a 2006 regulation — based on the precautionary principle — on the evaluation and authorization of chemicals that have been on (and approved for) the market for decades. Western regulations are getting ever more complex — and with the accumulation of regulations, the regulatory landscape facing innovators is ever more opaque. Such regulations hurt innovators and entrepreneurs that aspire to contest markets. Start-ups find it ever more challenging to manage political risks and investors shy away from new innovations that face an unclear legal territory. Take drones as an example. The technological challenges facing drone manufacturers and users are less daunting to many investors than unclear legal circumstances. Large firms have problems too, but their understanding of regulation — and their capacity to use it for competitive purposes — has become a new incumbency advantage, protecting firms against competition.

#### d. Government innovation fails---they have an incentive to slash R&D

McArdle 9 (Megan, columnist at Bloomberg View and a former senior editor at The Atlantic “Why I Oppose National Health Care” https://www.theatlantic.com/business/archive/2009/07/why-i-oppose-national-health-care/22300/)

Basically, for me, it all boils down to public choice theory. Once we've got a comprehensive national health care plan, what are the government's incentives? I think they're bad, for the same reason the TSA is bad. I'm afraid that instead of Security Theater, we'll get Health Care Theater, where the government goes to elaborate lengths to convince us that we're getting the best possible health care, without actually providing it. That's not just verbal theatrics. Agencies like Britain's NICE are a case in point. As long as people don't know that there are cancer treatments they're not getting, they're happy. Once they find out, satisfaction plunges. But the reason that people in Britain know about things like herceptin for early stage breast cancer is a robust private market in the US that experiments with this sort of thing. So in the absence of a robust private US market, my assumption is that the government will focus on the apparent at the expense of the hard-to-measure. Innovation benefits future constituents who aren't voting now. Producing it is very expensive. On the other hand, cutting costs pleases voters this instant. This is, fundamentally, what cries to "use the government's negotiating power" with drug companies is about. Advocates of such a policy spend a lot of time arguing about whether pharmaceutical companies do, or do not, spend too much on marketing. This is besides the point. The government is not going to price to some unknowable socially optimal amount of pharma market power. It is going to price to what the voters want, which is to spend as little as possible right now. It's not that I think that private companies wouldn't like to cut innovation. But in the presence of even rudimentary competition, they can't. Monopolies are not innovative, whether they are public or private.

## K

### 2AC – Alt Fails [SL]

#### Alt fails, Growth’s inevitable---empirics prove it’s human nature

Pethokoukis 21, James---Senior Fellow; Editor, AEIdeas Blog; and DeWitt Wallace Chair (“The 21st-century degrowth movement makes the same mistake about human nature as 20th-century socialists,” AEI, June 28, 2021, accessed Oct 2, 2021, https://www.aei.org/economics/the-21st-century-degrowth-movement-makes-the-same-mistake-about-human-nature-as-20th-century-socialists/)

\*edited for language

After the collapse of the Soviet Empire, Harvard University history professor Richard Pipes wrote in the essay “Human Nature and the Fall of Communism” that “a government that monopolizes a nation’s wealth and prohibits its citizens from accumulating any property beyond mere personal effects ensures its own destruction — if not from social or political explosion, then from chronic apathy, the sociopolitical equivalent of pernicious anemia.”

In other words, the Marxist-Leninist socialist notion that humanity was a blank slate upon which the Communist Party would write and thus create a New Soviet [hu]Man was doomed to failure. It ignored both the reality of human nature and its resilience. Indeed, the result in Soviet Russia was an economy marked by apathy and stagnation, and a society marked by corruption and repression. Again, Pipes:

The Communists wanted their citizens to give up, along with private property, personal ambitions, and to dedicate themselves wholly to the collective good. This aspiration has proven very difficult to realize, even in small utopian communities composed of idealistic volunteers. It was utterly unattainable in a vast empire held together by force. Rather than devote themselves 100 percent to the good of all, the vast majority of Soviet citizens dedicated themselves 100 percent to their private welfare. To members of the elite, the regime was an inexhaustible cornucopia that they skimmed mercilessly. Ordinary citizens interpreted the nationalization of all assets to mean that they had no stake in the country, since it belonged to someone else: since “they” owned it, let “them” take care of it. As a Soviet joke had it, “They pretend to pay us; we pretend to work.” Such attitudes resulted in a progressive alienation of the citizenry from the body politic.

Another anti-capitalist movement also suffers from a misunderstanding of human nature: the degrowthers who decry economic growth as environmentally unsustainable and beneficial only to a sliver of humanity. Of course, this ~~view~~ ignores the billions of still quite impoverished humans who would like to live like those in OECD countries. And then there’s those of us who currently live in rich countries and also would like higher incomes to acquire new goods, services, experiences, and opportunities. But don’t we in rich countries already have enough? Wouldn’t we be fine with stagnation or even a bit less? Certainly anyone having lived through the slow post-financial crisis economy should know better than to even pose such questions. I would also point to this telling example from economist Branko Milanovic’s newsletter:

I think that it could be reasonably argued that no group of people in the history of the world has lived as pleasant lives as today’s Italians. The advantages are well-known: lots of wealth, peace, moderate working hours, strong family and friendship bonds, nice weather, beautiful historical and natural sights, excellent and healthy food. Who then needs to grow? And Italy did not. It has by now stagnated for a generation and while in 1999, its GDP per capita was 3.5 times the world average, it is today 2.5 times. One could say, “it does not matter if people are happy”. But the problem is that, while superficially people may be happy this Summer as they congregate on the beaches and drink aperol, there is a deep malaise induced precisely by the absence of growth. The young are not happy because of lack of opportunities, the middle-aged people are not happy by non-challenging jobs, the old are not happy because their pensions are stagnant. So even if you have achieved a stagnant Arcadia, you cannot be happy and stop running because others are overtaking you and the fundamental features of capitalism, in Italy and elsewhere, are as I have described them above.

### 2AC – Sustainable (no ccs)

#### Decoupling [or dematerialization] makes growth sustainable—empirics, efficiency, substitution, consumption decline, innovation, financial oversight, and new reserves.

McAfee 19—(principal research scientist and codirector of the Initiative on the Digital Economy at MIT, PHD in business administration from Harvard, MS in mechanical engineering from MIT, unrelated to the crazy McAfee). McAfee, Andrew. 2019. More from Less: The Surprising Story of How We Learned to Prosper Using Fewer Resources—and What Happens Next. Scribner.

What’s behind the broad and deep dematerialization of the American economy? Why are we now post-peak in our consumption of so many resources? In the next chapters I’ll present my explanation of the causes of dematerialization. First, though, I want to give a short explanation of what the causes are not. In particular, I want to show that the CRIB strategies born around Earth Day and promoted since then for reducing our planetary footprint—consume less, recycle, impose limits, and go back to the land—have not been important contributors to the dematerialization we’ve seen. Since Earth Day, we have demonstrably not consumed much less or gone back to the land in large numbers. We have recycled a lot, but this fact is irrelevant because recycling is a separate phenomenon from dematerialization. Much more relevant than recycling are the limits we’ve imposed in a couple of areas. The history of these limits is instructive because it helps us separate great ideas (limits on pollution and hunting animals) from truly terrible ones (limits on family size). All, Consuming The C part of the CRIB strategy—a plea for us to consume less for the planet’s sake—has largely fallen on deaf ears. To see this, let’s look at change in the real GDP of the United States. It grew by an average of 3.2 percent per year between the end of World War II and Earth Day. From 1971 to 2017, it grew by an annual average of 2.8 percent. Population growth also slowed down after the postwar baby boom, but it remained positive. America’s population increased by an average of 1.5 percent a year from 1946 to 1970, and by 1 percent annually from 1971 to 2016. So while we have slowed down some, we certainly haven’t come close to embracing degrowth in our population or consumption. But the American economy has changed significantly since Earth Day and has become relatively less oriented around making and building things. Services, ranging from haircuts to insurance policies to concerts, now make up a much larger share of the economy than they did in 1970. US personal consumption of services has risen from 30 percent of GDP in 1970 to 47 percent in 2017. So, has the decline in resource use come about because we don’t make or consume as many products as we used to? No. While it’s true that products have been declining in relative terms (in other words, as a percentage of total GDP) compared to services, our total consumption of products has still been increasing in absolute terms. So has our industrial production—the total amount of things made in America. What’s more, the United States has not recently shifted away from “heavy” manufacturing. We still make lots of vehicles, machinery, and other big-ticket items, just as we used to. But we don’t make them the same way we used to. We now make them using fewer resources. To see this, let’s add a line showing US industrial production to our graph from the previous chapter of GDP and total metal consumption. This updated chart makes clear that the country hasn’t stopped producing things. Instead, America’s manufacturers have learned to produce more things from less metal. So to summarize, growth of consumption has in some cases slowed down in recent years. But growth in resource use has done much more than slow down—it has reversed course and is now generally negative. We have not as a society embraced degrowth. Instead, we’ve done something far stranger and more profound: we’ve decoupled growth—in consumption, prosperity, and our economy—from resource use. Early in the Industrial Era, the French diplomat Alexis de Tocqueville published his 1835 book, Democracy in America. One of the first major investigations into the character of the then-young country, it remains one of the best.I De Tocqueville observed almost two centuries ago that the people of the United States liked their things: “In America, the passion for material well-being… is general.… Minds are universally preoccupied with meeting the body’s every need and attending to life’s little comforts.” What’s new is that providing for our needs and comforts now requires fewer materials, not more. Recycling: Big, and Beside the Point Recycling is big business: 47 percent, 33 percent, 68 percent, and 49 percent of all the tonnage of aluminum, copper, lead, and iron and steel (respectively) consumed in the United States in 2015 came from scrap metal rather than ore taken from the earth. Similarly, almost 65 percent of paper products came from recycled newspapers, pizza boxes, and so on rather than from felled trees. Yet recycling is irrelevant for dematerialization. Why? Because recycling is about where resource-producing factories get their inputs, while dematerialization is about what’s happened to total demand for their outputs. Paper mills, for example, get their raw material from two main sources: recycling centers and forests. American consumption of output from all paper mills combined has been declining since 1990, the year of peak paper in the United States. This decline is purely a matter of how much total demand there is for paper; it has no direct relationship to the amount of recycling taking place. But is there any indirect relationship? How much would our total consumption of resources such as paper or steel change without recycling? It’s impossible to answer with certainty, but my intuition is that if recycling didn’t exist, our total consumption of resources such as aluminum, copper, iron, and steel would be declining even more quickly. This seems counterintuitive; the conclusion is supported by a simple chain of reasoning. Recycling metals makes economic sense exactly because it’s cheaper to melt down and reuse scrap than it is to dig out and process ore. Without this scrap, a ton of metal would probably cost more, all other things being equal. And as a general rule, we use less of a thing when it costs more. So it seems most likely to me that we’d use less metal overall in a hypothetical zero-recycling economy than we do in our actual enthusiastic-about-scrap-metal-recycling economy. This does not mean that I think metal recycling is bad. I think it’s great, since it gives us cheaper metal products and reduces total greenhouse gas emissions (since it takes much less energy to obtain metal from scrap than from ore). But recycling, whatever its merits, is not part of the dematerialization story. It’s a different story. Back to the Land Is Bad for the Land The back-to-the-land movement is a fascinating chapter in the history of American environmentalism, but a largely insignificant one. There were simply never enough homesteaders and others who turned away from modern, technologically sophisticated life to make much of a difference. Which is a good thing for the environment. As Jeffrey Jacob documents in his book New Pioneers, the back-to-the-land movement in the United States began in the mid-1960s and continued into the next decade. According to one estimate, as many as 1 million North American back-to-the-landers were living on small farms by the end of the 1970s. This, though, was a weak current against the strong tide of urban growth; the number of American city dwellers increased by more than 17 million between 1970 and 1980. Going back to the land might have been widely discussed, but it was comparatively rarely practiced. We should be thankful for this because homesteading is not great for the environment, for two reasons. First, small-scale farming is less efficient in its use of resources than massive, industrialized, mechanized agriculture. To get the same harvest, homesteaders use more land, water, and fertilizer than do “factory farmers.” Farms of less than one hundred acres, for example, grow 15 percent less corn per acre than farms with more than a thousand acres. And bigger farms get better faster. Between 1982 and 2012 farms under one hundred acres grew their total factor productivity by 15 percent, whereas farms over a thousand acres grew theirs by 51 percent. So more homesteaders would have meant more land under cultivation, more water and fertilizer used, and so on. Second, rural life is less environmentally friendly than urban or suburban dwelling. City folk live in high-density, energy-efficient apartments and condos, travel only short distances for work and errands, and frequently use public transportation. None of these things is true of country living. As economist Edward Glaeser summarizes, “If you want to be good to the environment, stay away from it. Move to high-rise apartments surrounded by plenty of concrete.… Living in the country is not the right way to care for the Earth. The best thing that we can do for the planet is build more skyscrapers.” And if homesteaders decide not only to ignore Glaeser’s advice but also to leave modernity further behind and heat their homes with coal or wood, they do still more environmental harm. Coal home furnaces create lots of atmospheric pollution, much more than comes from other kinds of fuel. Poland, for example, today has 80 percent of all homes in Europe that burn coal, and thirty-three of the Continent’s fifty most polluted cities. And burning wood means chopping down trees. A lot of them. It’s almost certainly the case that the English turned to coal for home heating in the middle of the sixteenth century because they’d cut down such a huge percentage of their trees that the price of wood skyrocketed. So if we care about the environment, we should probably be glad that the back-to-the-land movement stalled out, and that industrial-scale, high-yield agriculture has become the norm. A comprehensive review published in Nature Sustainability in 2018 concluded, “The data… do not suggest that environmental costs are generally larger for [high-yield] farming systems.… If anything, positive associations—in which high-yield, land-efficient systems also have lower costs in other dimensions—appear more common.” Imposing Limits: The Worst Idea, and the Best One Of the four elements of the CRIB strategy, the drive to impose limits has by far the most checkered history. It yielded both the most harmful strategies, and the most helpful ones. The Population Implosion In 1979 the government of the People’s Republic of China announced its new family planning policy, which soon became known as the one-child policy. It was enacted despite the steady decline in the country’s birth rate throughout the 1970s. But after reading Limits to Growth, A Blueprint for Survival, and other books limning the looming dangers of unchecked population expansion, the missile scientist Song Jian came to believe that even faster birth rate reductions were required. He became the architect of the new policy, the main effect of which was to limit ethnic Han Chinese families to a single child. Exceptions to this restriction included giving some couples the right to a second child if their first was a girl, but the one-child policy soon became a central fact of Chinese family life. It is hard to see it in a positive light. After the policy was officially abandoned in late 2015, journalist Barbara Demick wrote its unflattering obituary: “Family planning became a powerful bureaucracy, with officials who terrorized parents. They beat and burned down the houses of people who violated the family-planning limits. They snatched over-quota baby girls from the arms of their mothers and gave them to orphanages, which in turn put them up for adoption, earning a three-thousand-dollar ‘donation’ for each baby.” The Chinese government maintains that approximately 400 million births were prevented by the one-child policy, but this is probably a large overestimate. As the economist Amartya Sen points out, “The additional contribution of coercion to reducing fertility in China is by no means clear, since compulsion was superimposed on a society that was already reducing its birth rate.” In their 2013 essay “How Will History Judge China’s One-Child Policy?” the demographers Wang Feng, Yong Cai, and Baochang Gu compared the policy unfavorably to two of their country’s great twentieth-century convulsions: the Cultural Revolution and the Great Leap Forward. They wrote, “While those grave mistakes both cost tens of millions of lives, the harms done were relatively short-lived and were corrected quickly afterward. The one-child policy, in contrast, will surpass them in impact by its role in creating a society with a seriously undermined family and kin structure, and a whole generation of future elderly and their children whose well-being will be seriously jeopardized.” History, in short, will judge this government-imposed limit on family size harshly.II Rational Restrictions Imposing limits on family size is a terrible idea for reasons both practical and moral. But it’s an excellent idea to impose limits on pollution, and on hunting some animals and selling products that come from their bodies. Such restrictions have yielded the great triumphs of the conservation and environmental movements in America and other countries. In 1970, the same year as the original Earth Day festival, the United States established the federal Environmental Protection Agency and made major amendments to 1963’s Clean Air Act. This was the start of a cascade of laws and regulations aimed at reducing pollution and other environmental harms. These have worked amazingly well. For example, atmospheric levels of sulfur dioxide in the United States have dropped to levels not seen since the first years of the twentieth century, and other kinds of air pollution have also dropped sharply. From 1980 to 2015, total emissions of six principal air pollutants decreased by 65 percent. As lead was banned from paint and gasoline, the concentration of that element in the blood of young children dropped by more than 80 percent between 1976 and 1999. Because lead retards brain development during youth, these declines are tremendously important. According to one study, American children in 1999 had IQs that were on average 2.2 to 4.7 points higher than they would have been had lead concentrations remained at their 1970 levels. More work certainly remains, but thanks to the limits imposed on pollutants, America’s soil, air, and water are all much cleaner than they were on Earth Day. The conservationists who grew concerned in the early years of the twentieth century about what hunting was doing to the populations of many animals were the predecessors of Earth Day’s environmentalists. Conservationists were spurred to action by the shocking extinction of the passenger pigeon. That such an abundant bird could be eradicated stunned many and spurred new laws restricting trade in animal products. The first of these was the Lacey Act, passed by Congress in 1900 and named for John Lacey, a Republican representative from Iowa. As he said during debate on the bill, “The wild pigeon, formerly in flocks of millions, has entirely disappeared from the face of the earth. We have given an awful exhibition of slaughter and destruction, which may serve as a warning to all mankind. Let us now give an example of wise conservation of what remains of the gifts of nature.” The Lacey Act and its successors imposed three kinds of limits on taking and consuming animals. First, hunting of some animals was fully banned. Protected species include the sea otter, which was protected by a 1911 international moratorium; the snowy egret, which was ruthlessly hunted for its gorgeous plumes until passage of the Weeks-McLean Law Act in 1913; and dolphins and manatees, which were sheltered by 1972’s Marine Mammal Protection Act. Second, many limits have been imposed on when and where animals can be hunted. Sport and food hunting are illegal in most national parks, for example, and duck, bear, deer, and many other animals have well-defined hunting seasons. Third, bans have been imposed on the commercial trade in many animal products. The most sweeping of these is probably the nationwide ban on the sale of hunted meat. You may see venison or bison meat at a butcher’s counter or on a menu in America, but it always comes from a ranch, not a hunt. These imposed limits have brought many iconic American animals back from the brink of extinction. North America now has more than half a million bison, for example, and over three thousand sea otters live off the coast of Northern California. Some previously threatened animals have come back so well that they’re now widely considered pests. People in many American neighborhoods today feel that there are too many white-tailed deer, Canada geese, and beaver. The story of dematerialization is not the story of following the CRIB strategies. Except for the excellent idea of imposing limits on polluting and pursuing animals, these strategies were ignored (we didn’t embrace degrowth and stop consuming), abandoned (we stopping going back to the land), irrelevant (dematerialization has nothing to do with recycling), or deeply misguided (China’s attempt to limit family size was a huge mistake). So how did we finally start getting more from less? How did we become post-peak in our use of so many resources? The next three chapters will take up this critical question. CHAPTER 7 What Causes Dematerialization? Markets and Marvels The triumph of the industrial arts will advance the cause of civilization more rapidly than its warmest advocates could have hoped. —Charles Babbage, The Exposition of 1851; or, Views of the Industry, the Science, and the Government of England, 1851 If CRIB strategies aren’t responsible for the large-scale dematerialization of the American economy that has taken place since Earth Day, then what is? How have we got more from less? I believe that four main forces are responsible, and that it’s helpful to think of them as two pairs. In this chapter we’ll look at the first pair, then take up the second in chapter 9. Capitalism and technological progress are the first pair of forces driving dematerialization. This statement will come as a surprise to many, and for good reason. After all, it’s exactly this combination that caused us to massively increase our resource consumption throughout the Industrial Era. As we saw in chapter 3, the ideas of William Jevons and Alfred Marshall point to the distressing conclusion that capitalism and tech progress always lead to more from more: more economic growth, but also more resource consumption. So what changed? How are capitalism and tech progress now getting us more from less? To get answers to these important questions, let’s start by looking at a few recent examples of dematerialization. Fertile Farms America has long been an agricultural juggernaut. In 1982, after more than a decade of steady expansion due in part to rising grain prices, total cropland in the country stood at approximately 380 million acres. Over the next ten years, however, almost all of this increase was reversed. So much acreage was abandoned by farmers and given back to nature that cropland in 1992 was almost back to where it had been almost twenty-five years before. This decline had several causes, including falling grain prices, a severe recession, over-indebted farmers, and increased international competition. A final factor, though, was the ability to get ever-more corn, wheat, soybeans, and other crops from the same acre of land, pound of fertilizer and pesticide, and gallon of water. The material productivity of agriculture in the United States has improved dramatically in recent decades, as we saw in chapter 5. Between 1982 and 2015 over 45 million acres—an amount of cropland equal in size to the state of Washington—was returned to nature. Over the same time potassium, phosphate, and nitrogen (the three main fertilizers) all saw declines in absolute use. Meanwhile, the total tonnage of crops produced in the country increased by more than 35 percent. As impressive as this is, it’s dwarfed by the productivity improvements of American dairy cows. In 1950 we got 117 billion pounds of milk from 22 million cows. In 2015 we got 209 billion pounds from just 9 million animals. The average milk cow’s productivity thus improved by over 330 percent during that time. Thin Cans Tin cans are actually made of steel coated with a thin layer of tin to improve corrosion resistance. They’ve been used since the nineteenth century to store food. Starting in the 1930s, they began also to be used to hold beer and soft drinks.I In 1959 Coors pioneered beer cans made of aluminum, which is much lighter and more corrosion resistant than steel. Royal Crown Cola followed suit for soda five years later. As Vaclav Smil relates, “A decade later steel cans were on the way out, and none of them have been used for beer since 1994 and for soft drinks since 1996.… At 85 g the first aluminum cans were surprisingly heavy; by 1972 the weight of a two-piece can dropped to just below 21 g, by 1988 it was less than 16 g, a decade later it averaged 13.6 g, and by 2011 it was reduced to 12.75 g.” Manufacturers accomplished these reductions by making aluminum cans’ walls thinner, and by making the sides and bottom from a single sheet of metal so that only one comparatively heavy seam was needed (to join the top to the rest of the can). Smil points out that if all beverage cans used in 2010 weighed what they did in 1980, they would have required an extra 580,000 tons of aluminum. And aluminum cans kept getting lighter. In 2012 Ball packaging introduced into the European market a 330 ml can that held 7.5 percent less than the US standard, yet at 9.5 g weighed 25 percent less. Gone Gizmos In 2014 Steve Cichon, a “writer, historian, and retired radio newsman in Buffalo, NY,” paid $3 for a large stack of front sections of the Buffalo News newspaper from the early months of 1991. On the back page of the Saturday, February 16, issue was an ad from the electronics retailer Radio Shack. Cichon noticed something striking about the ad: “There are 15 electronic gimzo type items on this page.… 13 of the 15 you now always have in your pocket.” The “gizmo type items” that had vanished into the iPhone Cichon kept in his pocket included a calculator, camcorder, clock radio, mobile telephone, and tape recorder. While the ad didn’t include a compass, camera, barometer, altimeter, accelerometer, or GPS device, these, too, have vanished into the iPhone and other smartphones, as have countless atlases and compact discs. The success of the iPhone was almost totally unanticipated. A November 2007 cover story in Forbes magazine touted that the Finnish mobile phone maker Nokia had over a billion customers around the world and asked, “Can anyone catch the cell phone king?” Yes. Apple sold more than a billion iPhones within a decade of its June 2007 launch and became the most valuable publicly traded company in history. Nokia, meanwhile, sold its mobile phone business to Microsoft in 2013 for $7.2 billion to get “more combined muscle to truly break through with consumers,” as the Finnish company’s CEO Stephen Elop said at the time of the deal. It didn’t work. Microsoft sold what remained of Nokia’s mobile phone business and brand to a subsidiary of the Taiwanese electronics manufacturer Foxconn for $350 million in May of 2016. Radio Shack filed for bankruptcy in 2015, and again in 2017. From Peak Oil to… Peak Oil In 2007 US coal consumption reached a new high of 1,128 million short tons, over 90 percent of which was burned to generate electricity. Total coal use had increased by more than 35 percent since 1990, and the US Energy Information Administration (the official energy statisticians of the US government) forecast further growth of up to 65 percent by 2030. Also in 2007 the US Government Accountability Office (GAO), a federal agency known as “the congressional watchdog,” published a report with an admirably explanatory title: “Crude Oil: Uncertainty about Future Oil Supply Makes It Important to Develop a Strategy for Addressing a Peak and Decline in Oil Production.” It took seriously the idea of “peak oil,” a phrase coined in 1956 by M. King Hubbert, a geologist working for Shell Oil. As originally conceived, peak oil referred to the maximum amount of oil that we could annually produce for all of humanity’s needs. The first oil wells pumped out the crude oil that was closest to the earth’s surface or otherwise easiest to access. As those wells dried up, we had to drill deeper ones, both on land and at sea. As the world’s economies kept growing, so did total demand for oil, which kept getting harder and harder to obtain. Peak oil captured the idea that despite our best efforts and ample incentive, we would come to a time after which we would only be able to extract less and less oil year after year from the earth. Most of the estimates summarized in the GAO report found that peak oil would occur no later than 2040. The report did not mention fracking, which in retrospect looks like a serious omission. Fracking is short for “hydraulic fracturing” and is a means of obtaining oil and natural gas from rock formations lying deep underground. It uses a high-pressure fluid to cause fractures in the rock, through which oil and gas can flow and be extracted. The United States and other countries have long been known to have huge reserves of hydrocarbons in deep rock formations, which are often called shales. Companies had been experimenting with fracking to get at them since the middle of the twentieth century, but had made little progress. In 2000 fracking accounted for just 2 percent of US oil production. That figure began to increase quickly right around the time of the GAO report. Not because of any single breakthrough, but instead because the suite of tools and techniques needed for profitable fracking had all improved enough. A gusher of shale oil and gas ensued. Thanks to fracking, US crude oil production almost doubled between 2007 and 2017, when it approached the benchmark of 10 million barrels per day. By September of 2018 America had surpassed Saudi Arabia to become the world’s largest producer of oil. American natural gas production, which had been essentially flat since the mid-1970s, jumped by nearly 43 percent between 2007 and 2017. As a result of the fracking boom the United States has experienced peak coal rather than peak oil. And the peak in coal is not in total annual supply, but instead in demand. Fracking made natural gas cheap enough that it became preferred over coal for much electricity generation. By 2017 total US coal consumption was down 36 percent from its 2007 high point. The phrase peak oil is still around, but, as is the case with coal, it usually no longer refers to supply. As a 2017 Bloomberg headline put it, “Remember Peak Oil? Demand May Top Out Before Supply Does.” Even though the extra supply from fracking has helped push down oil and gas prices, many observers now believe that energy from other sources—the sun, wind, and the nuclei of uranium atoms—is getting cheaper faster and becoming much more widely available. So much so that, as a 2018 article in Fortune about the future of oil hypothesized, “This wouldn’t be just another oil-price cycle, a familiar roller coaster in which every down is followed by an up. It would be the start of a decades-long decline of the Oil Age itself—an uncharted world in which… oil prices might be ‘lower forever.’ ” Analysts at Shell, the company from which the phrase peak oil originated, now estimate that global peak oil demand might come as soon as 2028. Taking Stock of Rolling Stock My friend Bo Cutter started his career in 1968 working for Northwest Industries, a conglomerate that owned the Chicago and North Western Railway. One of his first assignments was to help a team tasked with solving a problem that sounds odd to modern ears: figuring out where CNW’s railcars were. These cars are massive metal assemblies, each weighing thirty tons or more. In the late 1960s CNW owned thousands of them, representing a huge commitment of both material and money. Across the railroad industry, the rule of thumb then was that about 5 percent of a company’s railcars moved on any given day. This was not because the other 95 percent needed to rest. It was because their owners didn’t know where they were. CNW owned thousands of miles of track in places as far from Chicago as North Dakota and Wyoming. Its rolling stock (as locomotives and railcars are called) could also travel outside the company’s network on tracks owned by other railroads. So these assets could be almost anywhere in the country. When the railcars weren’t moving, they sat in freight yards. At the time Cutter started his job, freight yards didn’t keep up-to-date records of the idle rolling stock they contained because, in the days before widespread digital computers, sensors, and networks, there was no way to cost-effectively know or communicate the location of each car. So it was impossible for CNW or any other railroad to systematically track its most important inventory, even though doing so would be hugely beneficial to the company’s bottom line. For example, Cutter’s team knew that if they could increase the percentage of cars moving each day from 5 percent to 10 percent, they would need only half as many of them. Even a single percentage point increase in freight-car use would yield major financial benefits. When Cutter started his assignment, CNW and all other railroads employed spotters, who visited yards and watched trains pass, then telegraphed their findings to the head office. Other railroads passed on similar information to collect the demurrage charges they were owed for each CNW car on their tracks and in their yards. Cutter’s team improved on these methods by making them more systematic and efficient. They put in place a better baseline audit of where railcars were, employed more spotters, painted CNW cars differently so they were easier to see, and explored how to make more use of a new tool for businesses: the digital computer. That tool and its kin are now pervasive in the railroad industry. In the early 1990s, for example, companies started putting radio-frequency identification tags on each piece of rolling stock. These tags would be read by trackside sensors, thus automating the work of spotting. At present over 5 million messages about railcar status and location are generated and sent throughout the American railway system every day, and the country’s more than 450 railroads have nearly real-time visibility over all their rolling stock. The Rare Earth Scare In September of 2010 the Japanese government took into custody the captain of a Chinese fishing boat that had collided with Japanese patrol vessels near a group of uninhabited islands in the East China Sea claimed by both countries. China responded by imposing an embargo on shipments of rare earth elements (REE) to the Land of the Rising Sun. Even though Japan relented almost immediately and released the captain, a global panic began. This is because rare earths are “vitamins of chemistry,” as USGS scientist Daniel Cordier puts it. “They help everything perform better, and they have their own unique characteristics, particularly in terms of magnetism, temperature resistance, and resistance to corrosion.” By 2010 China produced well over 90 percent of the world’s REE. Its actions in the wake of the maritime incident convinced many that it could and would take unilateral action to control the flow of these important materials, and panicked buying soon followed (along with its close cousin rampant speculation). A bundle of REE that would have sold for less than $10,000 in early 2010 soared to more than $42,000 by April of 2011. In September of that year the US House of Representatives held a hearing called “China’s Monopoly on Rare Earths: Implications for US Foreign and Security Policy.” China didn’t attain its near monopoly because it possessed anything close to 90 percent of global reserves of REE. In fact, rare earths aren’t rare at all (one, cerium, is about as common in the earth’s crust as copper). However, they’re difficult to extract from ore. Obtaining them requires a great deal of acid and generates tons of salt and crushed rock as by-products. Most other countries didn’t want to bear the environmental burden of this heavy processing and so left the market to China. In the wake of the embargo, this seemed like a bad idea. As Representative Brad Sherman put it during the congressional hearing, “Chinese control over rare earth elements gives them one more argument as to why we should kowtow to China.” But there was never much kowtowing. By the time of the hearing, prices for REE were already in free fall. Why? What happened to the apparently tight Chinese stranglehold over REE? Several factors caused it to ease, including the availability of other supply sources and incomplete maintenance of the embargo. But as public affairs professor Eugene Gholz noted in a 2014 report on the “crisis,” many users of REE simply innovated their way out of the problem. “Companies such as Hitachi Metals [and its subsidiary in North Carolina] that make rare earth magnets found ways to make equivalent magnets using smaller amounts of rare earths in the alloys.… Meanwhile, some users remembered that they did not need the high performance of specialized rare earth magnets; they were merely using them because, at least until the 2010 episode, they were relatively inexpensive and convenient.” Overall, the companies using REE found many inexpensive and convenient alternatives. By the end of 2017 the same bundle of rare earths that had been trading above $42,000 in 2011 was available for about $1,000.What’s Going On? There is no shortage of examples of dematerialization. I chose the ones in this chapter because they illustrate a set of fundamental principles at the intersection of business, economics, innovation, and our impact on our planet. They are: We do want more all the time, but not more resources. Alfred Marshall was right, but William Jevons was wrong. Our wants and desires keep growing, evidently without end, and therefore so do our economies. But our use of the earth’s resources does not. We do want more beverage options, but we don’t want to keep using more aluminum in drink cans. We want to communicate and compute and listen to music, but we don’t want an arsenal of gadgets; we’re happy with a single smartphone. As our population increases, we want more food, but we don’t have any desire to consume more fertilizer or use more land for crops. Jevons was correct at the time he wrote that total British demand for coal was increasing even though steam engines were becoming much more efficient. He was right, in other words, that the price elasticity of demand for coal-supplied power was greater than one in the 1860s. But he was wrong to conclude that this would be permanent. Elasticities of demand can change over time for several reasons, the most fundamental of which is technological change. Coal provides a clear example of this. When fracking made natural gas much cheaper, total demand for coal in the United States went down even though its price decreased. With the help of innovation and new technologies, economic growth in America and other rich countries—growth in all of the wants and needs that we spend money on—has become decoupled from resource consumption. This is a recent development and a profound one. Materials cost money that companies locked in competition would rather not spend. The root of Jevons’s mistake is simple and boring: resources cost money. He realized this, of course. What he didn’t sufficiently realize was how strong the incentive is for a company in a contested market to reduce its spending on resources (or anything else) and so eke out a bit more profit. After all, a penny saved is a penny earned. Monopolists can just pass costs on to their customers, but companies with a lot of competitors can’t. So American farmers who battle with each other (and increasingly with tough rivals in other countries) are eager to cut their spending on land, water, and fertilizer. Beer and soda companies want to minimize their aluminum purchases. Producers of magnets and high-tech gear run away from REE as soon as prices start to spike. In the United States, the 1980 Staggers Act removed government subsidies for freight-hauling railroads, forcing them into competition and cost cutting and making them all the more eager to not have expensive railcars sit idle. Again and again, we see that competition spurs dematerialization. There are multiple paths to dematerialization. As profit-hungry companies seek to use fewer resources, they can go down four main paths. First, they can simply find ways to use less of a given material. This is what happened as beverage companies and the companies that supply them with cans teamed up to use less aluminum. It’s also the story with American farmers, who keep getting bigger harvests while using less land, water, and fertilizer. Magnet makers found ways to use fewer rare earth metals when it looked as if China might cut off their supply. Second, it often becomes possible to substitute one resource for another. Total US coal consumption started to decrease after 2007 because fracking made natural gas more attractive to electricity generators. If nuclear power becomes more popular in the United States (a topic we’ll take up in chapter 15), we could use both less coal and less gas and generate our electricity from a small amount of material indeed. A kilogram of uranium-235 fuel contains approximately 2–3 million times as much energy as the same mass of coal or oil. According to one estimate, the total amount of energy that humans consume each year could be supplied by just seven thousand tons of uranium fuel. Third, companies can use fewer molecules overall by making better use of the materials they already own. Improving CNW’s railcar utilization from 5 percent to 10 percent would mean that the company could cut its stock of these thirty-ton behemoths in half. Companies that own expensive physical assets tend to be fanatics about getting as much use as possible out of them, for clear and compelling financial reasons. For example, the world’s commercial airlines have improved their load factors—essentially the percentage of seats occupied on flights—from 56 percent in 1971 to more than 81 percent in 2018. Finally, some materials get replaced by nothing at all. When a telephone, camcorder, and tape recorder are separate devices, three total microphones are needed. When they all collapse into a smartphone, only one microphone is necessary. That smartphone also uses no audiotapes, videotapes, compact discs, or camera film. The iPhone and its descendants are among the world champions of dematerialization. They use vastly less metal, plastic, glass, and silicon than did the devices they have replaced and don’t need media such as paper, discs, tape, or film. If we use more renewable energy, we’ll be replacing coal, gas, oil, and uranium with photons from the sun (solar power) and the movement of air (wind power) and water (hydroelectric power) on the earth. All three of these types of power are also among dematerialization’s champions, since they use up essentially no resources once they’re up and running. I call these four paths to dematerialization slim, swap, optimize, and evaporate. They’re not mutually exclusive. Companies can and do pursue all four at the same time, and all four are going on all the time in ways both obvious and subtle. Innovation is hard to foresee. Neither the fracking revolution nor the world-changing impact of the iPhone’s introduction were well understood in advance. Both continued to be underestimated even after they occurred. The iPhone was introduced in June of 2007, with no shortage of fanfare from Apple and Steve Jobs. Yet several months later the cover of Forbes was still asking if anyone could catch Nokia. Innovation is not steady and predictable like the orbit of the Moon or the accumulation of interest on a certificate of deposit. It’s instead inherently jumpy, uneven, and random. It’s also combinatorial, as Erik Brynjolfsson and I discussed in our book The Second Machine Age. Most new technologies and other innovations, we argued, are combinations or recombinations of preexisting elements. The iPhone was “just” a cellular telephone plus a bunch of sensors plus a touch screen plus an operating system and population of programs, or apps. All these elements had been around for a while before 2007. It took the vision of Steve Jobs to see what they could become when combined. Fracking was the combination of multiple abilities: to “see” where hydrocarbons were to be found in rock formations deep underground; to pump down pressurized liquid to fracture the rock; to pump up the oil and gas once they were released by the fracturing; and so on. Again, none of these was new. Their effective combination was what changed the world’s energy situation. Erik and I described the set of innovations and technologies available at any time as building blocks that ingenious people could combine and recombine into useful new configurations. These new configurations then serve as more blocks that later innovators can use. Combinatorial innovation is exciting because it’s unpredictable. It’s not easy to foresee when or where powerful new combinations are going to appear, or who’s going to come up with them. But as the number of both building blocks and innovators increases, we should have confidence that more breakthroughs such as fracking and smartphones are ahead. Innovation is highly decentralized and largely uncoordinated, occurring as the result of interactions among complex and interlocking social, technological, and economic systems. So it’s going to keep surprising us. As the Second Machine Age progresses, dematerialization accelerates. Erik and I coined the phrase Second Machine Age to draw a contrast with the Industrial Era, which as we’ve seen transformed the planet by allowing us to overcome the limitations of muscle power. Our current time of great progress with all things related to computing is allowing us to overcome the limitations of our mental power and is transformative in a different way: it’s allowing us to reverse the Industrial Era’s bad habit of taking more and more from the earth every year. Computer-aided design tools help engineers at packaging companies design generations of aluminum cans that keep getting lighter. Fracking took off in part because oil and gas exploration companies learned how to build accurate computer models of the rock formations that lay deep underground—models that predicted where hydrocarbons were to be found. Smartphones took the place of many separate pieces of gear. Because they serve as GPS devices, they’ve also led us to print out many fewer maps and so contributed to our current trend of using less paper. It’s easy to look at generations of computer paper, from 1960s punch cards to the eleven-by-seventeen-inch fanfold paper of the 1980s, and conclude that the Second Machine Age has caused us to chop down ever more trees. The year of peak paper consumption in the United States, however, was 1990. As our devices have become more capable and interconnected, always on and always with us, we’ve sharply turned away from paper. Humanity as a whole probably hit peak paper in 2013. As these examples indicate, computers and their kin help us with all four paths to dematerialization. Hardware, software, and networks let us slim, swap, optimize, and evaporate. I contend that they’re the best tools we’ve ever invented for letting us tread more lightly on our planet. All of these principles are about the combination of technological progress and capitalism, which are the first of the two pairs of forces causing dematerialization. Technology: The Human Interface with the Material World One of my favorite definitions of technology comes from the philosopher Emmanuel Mesthene, who called it “the organization of knowledge for the achievement of practical purposes.” Sometimes that knowledge is crystallized into products such as hammers and iPhones, and sometimes it exists as techniques such as those for fracking or precision agriculture. Like knowledge itself, technologies accumulate. We haven’t forgotten about the lever, the plow, or the steam engine in the Second Machine Age, and we haven’t had to give them up to use cloud computing or drones. Like innovation itself, technologies are combinatorial; most of them are combinations or recombinations of existing things. This implies that the number of potentially powerful new technologies increases over time because the number of available building blocks does. These facts help me understand why we didn’t start to dematerialize sooner. It could simply be that we didn’t have the right technologies, or enough building blocks, to allow large-scale dematerialization. We had technologies that made it feasible and profitable for us to grow by taking more and more from the earth—more and more metals, fuels, water, fertilizers, and so on—but not ones that made it possible to profitably grow while taking less and less. In the Second Machine Age, that has changed. My other preferred definition of technology comes from the great science fiction author Ursula K. Le Guin, who wrote, “Technology is the active human interface with the material world. Its technology is how a society copes with physical reality: how people get and keep and cook food, how they clothe themselves, what their power sources are (animal? human? water? wind? electricity? other?), what they build with and what they build, their medicine—and so on and on. Perhaps very ethereal people aren’t interested in these mundane, bodily matters, but I’m fascinated by them.” So am I, because these “mundane matters” have twice reshaped the world—first during the Industrial Era, when technological progress allowed us to prosper by taking more from the planet, and now in the Second Machine Age, when we’ve finally figured out how to prosper while taking less. Capitalism: Means of Production Capitalism and religion are the two subjects that leave the fewest people on the sidelines. People have very firmly held opinions on both topics, and few change their minds no matter what evidence and arguments are presented to them. Yet despite this clear history of intransigence, many thinkers and writers have tried to bring others around to their point of view on both topics. Most have failed. I’m going to join this long sad parade by arguing in favor of capitalism. Before I do that, though, I want to define what I’m talking about. Even more than is the case with technology, clear definitions are important with capitalism because it’s such a triggering word. As the psychologist Jonathan Haidt has pointed out, some hear it as a synonym for liberation, others for exploitation. But let me put the dictionary before the thesaurus and offer a definition of what capitalism is before suggesting what it’s like. For our purposes, capitalism is a way to come up with goods and services and get them to people. Every society that doesn’t want its people to starve or die of exposure has to accomplish this task; capitalism is simply one approach to doing it. The important features of this approach are: Profit-seeking companies. Under capitalism, most goods and services are produced by for-profit companies rather than nonprofits, the government, or individuals. Companies can be owned by only a few people (such as the partners in a law firm) or a great many (publicly traded companies have shareholders all over the world) and are assumed to last over time; they don’t have a predefined end date. Free market entry and competition. Companies can go after one another’s markets and customers; there are few if any protected monopolies. It might not be legal to completely copy a rival’s patented product, but it’s perfectly legal to try to come up with something better. In economist-speak, markets are contested. Similarly, people can take their skills from one market to another; they’re not tied to a single geography or job. Strong property rights and contract enforcement. Patents are a form of intellectual property. They can be bought and sold just as other kinds of property—from land to houses to cars—can. Laws and courts ensure that none of these kinds of property can be stolen or destroyed, even by large, powerful entities such as billionaires, giant corporations, or the government. Similarly, if a small company and a big one sign a contract to work together, neither party gets to unilaterally walk away from the agreement without fear of getting sued. Absence of central planning, control, and price setting. The government does not decide what goods and services are needed by people, or which companies should be allowed to produce them. No central body decides if there is “enough” volume and variety in smartphones, caffeinated beverages, steel girders, and so on. The prices of these and most other goods and services are allowed to vary based on the balance of supply and demand, rather than being set in advance or adjusted by any central authority. Private ownership of most things. Smartphones, cups of coffee, steel girders, and most other products are owned by the people or companies that bought them. The companies that produced these things are also owned by people. Many shares of Apple, Starbucks, US Steel, and other public companies are held by mutual funds, pension funds, and hedge funds, but all these funds are themselves ultimately owned by people. Most houses, cars, land, gold, Bitcoin, and other assets are also owned by people rather than the government. Voluntary exchange. The phrase most closely associated with capitalism is voluntary exchange. People can’t be forced to buy specific products, take a certain job, or move across the country. Companies don’t have to sell themselves if they don’t want to. They also don’t have to make some products and not others, or stay within specific markets. The Waffle House chain doesn’t have any of its breakfast restaurants in my state of Massachusetts, but that’s not because lawmakers there are keeping it out. The legislature in Boston doesn’t have that power. I want to highlight a couple of things about this definition. First, capitalism is not without oversight. The government has clear roles to play in establishing laws and settling disputes (to say nothing of setting tax rates, controlling the money supply, and doing other things of critical economic importance). As we’ll see in the next two chapters, every sane advocate of capitalism also recognizes that while voluntary exchange and free market entry are great, they don’t create utopia. Some important “market failures” need to be corrected by government action. The second thing I want to point out is that all of today’s rich countries are capitalist, by this definition. This is not to say that all capitalist countries are alike. Denmark, South Korea, and the United States are very different places. They have dissimilar trade policies, tax systems, social safety nets, industrial structures, and so on. But they all have all of the things listed above; they are all inherently capitalist. Denmark’s economy is not planned and controlled out of Copenhagen, people in Korea own their own houses and furniture,III and contracts in America are generally respected and enforced. Today’s poorer countries, in sharp contrast, reliably do not have all of the things listed above. Their governments tend to run such things as airlines and telephone networks that are run by private companies in rich countries. It’s generally much harder to start a company in less affluent countries, so free market entry and competition are constrained. According to the World Bank, in 2017 it took less than six days to start a business in America, Denmark, Singapore, Australia, and Canada, and seventy days or more in Somalia, Brazil, and Cambodia. The world champion of entrepreneurial sclerosis was Venezuela (a country we’ll talk more about in the next chapter), at two hundred and thirty days. In poorer countries, it’s also often not clear who owns what. Things that are taken for granted in the rich world, such as unambiguous land registries and clear title to houses and other property, are problematic in many developing countries. The biggest difference between rich and poor countries might be whether laws are clearly and consistently enforced. Poorer countries don’t lack laws; they often have extensive legal codes. What’s in short supply is justice for all. Officials are corrupt; the elite get special treatment and rarely lose in court; police, regulators, and inspectors can expect bribes; and contested markets, property rights, and voluntary exchange suffer in countless other ways. It’s not that these abuses don’t occur in rich countries, but they occur much, much less often. I’ll make some more points about capitalism in the next chapter. To wrap up this one, I want to emphasize how well technological progress and capitalism work together. Overcoming the Limits A great way to see what happens when capitalism and tech progress combine is to look back at 1972’s The Limits to Growth, which we first came across in chapter 4. It’s a fascinating document for two reasons. First, it’s one of the most Malthusian books written since Malthus. It’s far gloomier than anything Jevons came up with. The team behind The Limits to Growth tried to model the future of the exponentially growing world economy and concluded, “We can thus say with some confidence that, under the assumption of no major change in the present system, population and industrial growth will certainly stop within the [twenty-first] century, at the latest. The system… collapses because of a resource crisis.” Second, The Limits to Growth provided an invaluable service by recording what the known global reserves of important resources were in 1972. “Known global reserves” are the deposits of a resource that can be profitably extracted given the prevailing knowledge and state of technology. The authors of The Limits to Growth included the known reserves of many resources to show how inadequate they were in the face of exponential growth of both output and resource consumption. The authors had little reason to suppose in the early 1970s that either kind of growth would stop on its own. As we saw in chapter 4, resource consumption went up in lockstep with overall economic output all throughout the twentieth century up to Earth Day. Few people expected that to change. The team behind The Limits to Growth certainly didn’t. The most generous estimate of future resource availability included in The Limits to Growth assumed that exponential consumption would continue, and that proven reserves were actually five times greater than commonly assumed. Under these conditions, the team’s computer models showed that the planet would run out of gold within twenty-nine years of 1972; silver within forty-two years; copper and petroleum within fifty; and aluminum within fifty-five. These weren’t accurate predictions. We still have gold and silver, and we still have large reserves of them. In fact, the reserves of both are actually much bigger than in 1972, despite almost half a century of additional consumption. Known global reserves of gold are almost 400 percent larger today than in 1972, and silver reserves are more than 200 percent larger. And it’s probably not too early to say that we’re not going to run out of copper, aluminum, and petroleum as quickly as estimated in The Limits to Growth. Known reserves of all are much larger than they were when the book was published. Known aluminum reserves are almost twenty-five times what they were in the early 1970s. How could these predictions about resource availability, which were taken seriously when they were released, have been so wrong? Because the Limits to Growth team pretty clearly underestimated both dematerialization and the endless search for new reserves. Capitalism and tech progress combine to drive both of these trends—the use of fewer resources and the hunt for more of them—and neither of these two drivers is about to become less powerful. So we’ll continue to innovate our way to greater dematerialization while we keep finding more reserves. The counterintuitive conclusion from this line of reasoning is that resource scarcity isn’t something we need to worry about. The earth is finite, so the total quantity of resources such as gold and petroleum is limited. But the earth is also very, very big—big enough to contain all we need of these and other resources, for as long as we’ll need them. The image of a thinly supplied Spaceship Earth hurtling through the cosmos with us aboard is compelling, but deeply misleading. Our planet has amply supplied us for our journey. Especially since we’re quickly slimming, swapping, optimizing, and evaporating our way to dematerialization. The Second Enlightenment Abraham Lincoln, the only US president to hold a patent,IV had a deep insight about capitalism. He wrote that the patent system “added the fuel of interest to the fire of genius in the discovery and production of new and useful things.” “The fire of genius” is a wonderful label for technological progress. “The fuel of interest” is equally good as a summary of capitalism. They interact in a self-reinforcing and ever-expanding cycle, and they’re now creating a dematerializing world. Innovators come up with new and useful technologies. They then partner with entrepreneurs or become entrepreneurs themselves as James Watt did. A new company is the result. Investors such as steam-engine backer Matthew Boulton often join in to provide the capital needed for growth in its early days. The start-up enters a market and takes on incumbents like the Newcomen steam engine. Customers like the new technology better and are free to choose it. Rivals can’t just copy the new technology because it’s protected by patents. So they either have to license it or come up with innovations themselves. The start-up grows and prospers and eventually becomes the new incumbent. Its success inspires the next round of innovators, entrepreneurs, and investors, who once again take aim at the incumbent by offering something better to their customers. Because of free market entry, the next innovators and start-ups can come from anywhere. And because innovation is such a distributed, dynamic, and unpredictable activity, it often comes from an unexpected place. It’s not necessary to plan this process. In fact, it’s a terrible idea to try to do so. Any central planner will miss many of the actual innovators or actively try to squelch them to protect the status quo of which the planners themselves are a part. This cycle of capitalist, technology-rich “creative destruction” was beautifully described in the middle of the twentieth century by the Austrian economist Joseph Schumpeter. But since the late nineteenth century and the work of Alfred Marshall and William Jevons, we’ve believed that this cycle would cause us to use up more and more of our planet’s resources. This was true throughout the Industrial Era, and especially in the years around Earth Day and the birth of the modern environmental movement. Environmentalists’ urgent cautions about resource use and planetary depletion were born out of an awareness of how powerfully technological progress and capitalism interacted. But then, for the reasons described in this chapter, that interaction changed. Tech progress and capitalism continued to reinforce each other, and to cause economies to get bigger and people to become more prosperous. But instead of also causing greater use of natural resources, they instead sparked dematerialization, something truly new under the sun. The fuel of interest in eliminating costs was added to the fire of the computer revolution, and the world began to dematerialize. The economic historian Joel Mokyr argues that the Industrial Era was made possible by the values of the Enlightenment. This intellectual movement began in the second half of the eighteenth century with many societies in the West embracing what Steven Pinker characterizes as four values: reason, science, humanism, and progress. According to Mokyr, the Enlightenment created a “culture of growth” that let both capitalism and technological progress flourish. I see an interesting inversion taking place now. If the Enlightenment led to the Industrial Era, then the Second Machine Age has led to a Second Enlightenment—a more literal one. We are now lightening our total consumption and treading more lightly on our planet. In America, the United Kingdom, and other rich countries, we are past “peak stuff” and are now using fewer total resources year after year. We’re accomplishing this because of the combination of technological progress and capitalism, which now let us get more from less.

## 2AC – Tradeoff

#### 2. Nonunique---9th Circuit decision in SRP set important new antitrust precedent.

**Penrod 2-2** --- Journalist for Utility Dive.

Emma, 2-2-2022, "Appeals court decision opens door to sue public power utilities for rooftop solar fees under antitrust law," Utility Dive, https://www.utilitydive.com/news/appeals-court-decision-opens-door-to-sue-public-power-utilities-for-rooftop/618147/

The court rejected a defense raised by SRP, which argued that its actions did not violate antitrust law because the rooftop solar industry is thriving in Arizona in spite of the rate increase. Writing for the court, Judge Eric D. Miller noted that SRP's decision to raise rates could represent "coercive activity" intended to render independent solar systems uneconomical — activity that could warrant litigation. And because SRP's board of directors is not subject to oversight by the Arizona Corporation Commission, the state law that protects regulated utilities from antitrust litigation does not apply to SRP, Miller concluded.

Miller also noted that SRP had previously created financial incentives for customers who installed solar panels. However, these incentives were eliminated and rates raised after SRP's own attempts to enter the solar energy market did not bear fruit.

The ruling did, however, affirm the previous court's finding that the Local Government Antitrust Act shields SRP from federal antitrust damages — a positive outcome from SRP's perspective.

"With regard to the few remaining claims that were remanded to Judge [Susan] Brnovich [of the Arizona district court] for additional proceedings, SRP is confident that the SRP Board actions...will be determined to have been rationally considered and adopted, and not in violation of any law or statute," SRP spokesperson Scott Harelson said in a statement. "SRP believes that the few remaining claims in the plaintiff's allegations are without merit and that SRP will ultimately prevail in this matter."

But whether or not they do prevail in the long run, the 9th Circuit decision could establish an important precedent for future cases, according to Rich.

"It's been completely obvious for a decade now that utilities are ganging up on rooftop solar," Rich said. "If that's not antitrust, I don't know what is. This decision makes it easier to get a remedy and will hopefully make utilities think twice about their monopolistic actions."

#### New plaintiff-favoring standard in antitrust case expanded scope of liability across the board.

**Brody 1-26** --- Senior reporter at Protocol focusing on how Congress, courts and agencies affect the online world we live in.

Ben, 1-26-2022, "The FTC's antitrust case against Meta could be great for privacy," Protocol — The people, power and politics of tech, https://www.protocol.com/policy/ftc-meta-privacy-antitrust

Right after Thanksgiving in 2011, the Federal Trade Commission [announced](https://www.ftc.gov/news-events/press-releases/2011/11/facebook-settles-ftc-charges-it-deceived-consumers-failing-keep) it had caught Facebook in several lies about privacy occurring over the prior two years. The company, it said, had agreed to a settlement and would be making [changes](https://www.ftc.gov/sites/default/files/documents/cases/2011/11/111129facebookagree.pdf) going forward to protect users’ data.

The agreement, to put it mildly, doesn’t seem to have gone as the FTC planned. One $5 billion [fine](https://www.ftc.gov/news-events/press-releases/2019/07/ftc-imposes-5-billion-penalty-sweeping-new-privacy-restrictions) for privacy abuses and an unending stream of [scandals](https://www.protocol.com/policy/haugen-facebook-eight-takeaways) later, the FTC is in the middle of litigation with the company now known as Meta over alleged antitrust violations, which were long thought to belong to an entirely separate area of law.

In a judge’s recent [ruling](https://www.protocol.com/bulletins/ftc-antitrust-meta-proceed) in the competition case, though, the FTC may have found a surprising lever to get a handle on Big Tech’s data practices.

On Jan. 11, Judge James Boasberg denied Meta’s motion to dismiss the suit, essentially finding that if everything in the FTC’s complaint turns out to be true, the commission has put together a legally sound case. It’s an admittedly plaintiff-friendly standard and proving all the claims are indeed true may well still be a “tall task” for the FTC once Meta can present its own evidence and arguments, Boasberg wrote. Still, at least as far as he was concerned, the FTC wasn’t invoking absurd or discredited legal theories.

That’s where privacy comes in: While the FTC alleges that Meta's acquisitions of Instagram and WhatsApp were anticompetitive, the commission also contends that the company’s shoddy privacy record arose because it faces no meaningful competition from rivals that might offer better data protections.

Other antitrust cases have looked at data as an asset, or [complained](https://www.protocol.com/policy/facebook-privacy-competition) that privacy protections are a [pretext](https://www.theverge.com/2019/9/10/20859399/linkedin-hiq-data-scraping-cfaa-lawsuit-ninth-circuit-ruling) for anticompetitive behavior. In the lead-up to the FTC’s [filing](https://www.protocol.com/bulletins/facebook-antitrust-lawsuit) of the case in 2020, though, antitrust traditionalists and even some sympathetic experts essentially dismissed the novel notion that an enforcer could invoke privacy as a casualty of tech consolidation. They said it was academic at best — and at worst, a harebrained effort to cram the two main objections to Big Tech into one case.

Since the 1980s, judges in antitrust cases have looked for plaintiffs to focus on measurable price increases to consumers or, occasionally, to quantifiably decreased output. Privacy is neither, traditionalists pointed out, though it could be theoretically possible to analyze privacy as a type of product quality, and plaintiffs do sometimes invoke worse offerings to show harm. But even then, traditionalists said courts haven’t liked substituting their judgments about product quality for consumers’ opinions.

Jim Tierney, who had previously spent a decade overseeing tech-sector antitrust enforcement at the Justice Department, [said](https://www.bloomberg.com/news/articles/2019-11-25/privacy-lapses-could-be-part-of-google-facebook-antitrust-cases) at the time that a lawsuit “based on a data privacy theory of harm is not in the cards.” (Tierney was in private practice, and his law firm, Orrick Herrington & Sutcliffe, did work for Facebook, though he said he in particular didn’t.)

The FTC didn’t listen to the naysayers. In its original [complaint](https://storage.courtlistener.com/recap/gov.uscourts.dcd.224921/gov.uscourts.dcd.224921.3.0_2.pdf), which was filed by a Republican-led commission during the Trump administration, the FTC cited potential benefits of more competition, including a boost in the “availability, quality, and variety of data protection privacy options for users, including, but not limited to, options regarding data gathering and data usage practices.”

Boasberg eventually [dismissed](https://www.protocol.com/facebook-ftc-complaint-dismissed) that complaint, though he let the FTC try again and expressed no concerns about the claims regarding data protection. In the meantime, [Lina Khan](https://www.protocol.com/tag/lina-khan), a well-known critic of tech companies — and of the bipartisan focus, dating to the Reagan era, on prices in antitrust cases — had taken over the commission as chair.

Khan [made clear](https://www.protocol.com/policy/lina-khan-privacy) in her academic writing, before joining the FTC, that she sees a nexus between privacy and competition. In fact, academics in general had been [interested](https://www.nytimes.com/2020/12/20/technology/antitrust-case-google-facebook.html) in the link between competition and privacy. Even some Republican enforcers — like Makan Delrahim, head of the DOJ Antitrust Division during the Trump administration — [floated](https://www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-harvard-law-school-competition) similar notions, which found their way into the antitrust [complaint](https://storage.courtlistener.com/recap/gov.uscourts.dcd.223205/gov.uscourts.dcd.223205.1.0_4.pdf) he [filed](https://www.protocol.com/google-justice-department-lawsuit-antitrust) against Google.

The [revised FTC complaint](https://www.protocol.com/bulletins/ftc-new-facebook-complaint), which Khan led, landed last summer and [zeroed](https://digiday.com/media/facebook-fights-ftcs-new-privacy-themes-in-revised-antitrust-case/) in on these issues, detailing how Facebook allegedly worsened privacy among other, more traditional harms.

“Facebook has also engaged in other activities that have degraded the user experience, including the misusing or mishandling of user data,” the revised complaint [said](https://storage.courtlistener.com/recap/gov.uscourts.dcd.224921/gov.uscourts.dcd.224921.82.0.pdf), citing both the FTC’s 2011 privacy order and the 2019 mega-fine. “Facebook’s ability to harm users by decreasing product quality, without losing significant user engagement, indicates that Facebook has market power.”

‘Consumers care’

Despite the academic interest, and prosecutors’ claims in their lawsuits, there isn’t much modern precedent in the U.S. directly justifying Khan’s move. Even in the EU, where antitrust enforcement is relatively stronger, especially against tech, the [question](https://techcrunch.com/2021/03/24/competition-challenge-to-facebooks-superprofiling-of-users-sparks-referral-to-europes-top-court/) is [fraught](https://www.reuters.com/business/legal/german-court-turns-top-european-judges-help-facebook-data-case-2021-03-24/).

Meta wasn’t shy about pointing out the lack of prior rulings. “No court has ever endorsed the theory the FTC espouses here: that the amount of ‘privacy’ on a service can demonstrate monopoly power,” the company [wrote](https://storage.courtlistener.com/recap/gov.uscourts.dcd.224921/gov.uscourts.dcd.224921.83.1_3.pdf) when asking to have the new complaint dismissed. Indeed, Meta suggested, privacy can’t even be measured, and consumers have proven they like the status quo of free, ad-powered services.

That’s the motion that failed earlier this month when Boasberg said the FTC’s case could continue.

Boasberg cited existing statutes relating to spam to point out that actually, people might care deeply about such things. “The advent of federal legislation addressing various privacy and advertising concerns related to consumer technology is consistent with the intuitive notion that consumers care about these issues and may prefer stronger protections” in social networking, he [wrote](https://storage.courtlistener.com/recap/gov.uscourts.dcd.224921/gov.uscourts.dcd.224921.90.0_2.pdf).

His ruling doesn’t seem to have been a one-off in federal courts, either. Three days after it came down, a U.S. judge in California [denied](https://storage.courtlistener.com/recap/gov.uscourts.cand.369872/gov.uscourts.cand.369872.214.0.pdf) part of Meta’s motion to dismiss a different antitrust lawsuit. That complaint comes from a group of consumers and advertisers whose allegations, as Judge Lucy Koh put it, include the notion that, “without competition, Facebook can extract additional ‘personal information and attention’ from users.”

Koh, too, allowed the privacy claims to proceed, writing: “Consumers have adequately alleged that their injury ‘flows’ from Facebook’s anticompetitive conduct.”

Alex Harman, competition policy advocate at liberal consumer advocacy group Public Citizen, said the FTC’s handling of privacy in the Meta case shows why enforcers should push the boundaries of competition law rather than relying on old interpretations that might not account for current business models.

“You might lose, but you might also win, and then you expand the coverage of the law,” he said, adding that the U.S. might have stopped Google’s [acquisition](https://www.bbc.com/news/technology-55662659) of Fitbit and other deals if there had been better precedent.

Harman said that if that part of the FTC’s case ultimately prevails (in what could be a years-long [process](https://www.protocol.com/policy/tech-lawsuits-22)), it could be a boon not only to enforcers and other plaintiffs who want to bring cases based on privacy concerns with Big Tech, but also all kinds of product issues.

“The implication is far beyond just the biggest tech companies,” he said. “You could sub in any feature or benefit that is being anticompetitively squeezed out as a result of a consolidation.”

#### No US-China War

Bremmer, 20

(Ian Bremmer, foreign affairs columnist and editor-at-large at TIME, 12-28-2020, "No, the U.S. and China Are Not Heading Towards a New Cold War," Time, <https://time.com/5920725/us-china-competition/>) AM\*

First, a critical point that gets overlooked in the “new Cold War” debate: The first Cold War emerged in the absence of an existing world order, following the wreckage of World War II. Unlike today, there were no **well-established multilateral institutions** (or multinational corporations as well entrenched as they are today) that could **act as brakes to escalating conflicts**. Even more importantly, the aftermath of the second World War ushered in a decolonization trend that created dozens of new nations which were suddenly up for grabs—a critical component of the old Cold War as the U.S. and U.S.S.R. competed across the world to win hearts, minds and governments to their respective sides. In 2020, countries are looking to hedge between the world’s two economic superpowers more than they are looking to throw in their lot with one or the other. Which leads to the second point—**the interdependence that exists between the U.S. and China in 2020** is vastly different than the interdependence that existed between the U.S. and the U.S.S.R. in the middle of the 20th century. For the U.S. and the U.S.S.R., the only real common interest they had was avoiding mutually assured destruction via nuclear warfare. For all the recent turmoil, China has been a tremendous economic beneficiary of the current world order even if they take issue with some aspects of it; Beijing isn’t looking to upend the global order as much as it is trying to carve out more space within it to accommodate its own primacy. Furthermore, **there are numerous areas that both China and the U.S. need to cooperate for both their sakes: nuclear proliferation, macroeconomic stability, climate change and the** current pandemic **chief among them.** That cooperation is helped along by the decades of investment and relationships that have been built-up by critical stakeholders in both countries, even if they’ve been tested mightily in recent years. Point number three: [**China’s military might**](https://www.eastasiaforum.org/2020/12/16/chinas-military-modernisation/) **is nowhere near what the U.S.’s is, and it doesn’t look to be challenging the U.S. for global military supremacy anytime soon** (though its sphere in Asia is another matter). This is a critical distinction with the old Cold War, where the U.S.S.R. was never a serious economic competitor to the U.S., even though it was a military one. That matters—in the U.S., there was a belief that the U.S.S.R. could be defeated, as it was largely a military confrontation. However misguided the reasoning behind that belief might have been at the time, it turned out to be true. No one really believes that China can be defeated in the same sense—in fact, destroying China economically would devastate the U.S. economy as well. That means the best both can hope for is uneasy peace as the U.S. and China compete in greater and lesser degrees across a wide variety of areas, and even cooperate in some. That doesn’t set the path towards a new Cold War. Finally, there are the policy limitations of both countries to consider. Given the actual goals of both countries, **entering a genuine Cold War would be a massive strategic blunder**, and something to be avoided at all costs. The U.S. is not looking to expand its international footprint, but actually to do less on the international stage; that’s the exact opposite of what waging a Cold War with China would entail. Meanwhile, **China’s economic rise has left it with some key vulnerabilities** both domestically (ex: significant amounts of corporate debt, a labor base that’s getting more expensive while also getting less productive as manufacturing becomes increasingly automated) and internationally (ex: a massive amount of investment in economically weak countries) which makes it a serious question whether China could even wage a Cold War with the U.S. even if it wanted to. That doesn’t mean there aren’t real dangers or areas of disagreement between the U.S. and China: [Hong Kong](https://time.com/5915459/joshua-wong-hong-kong/), Taiwan, the South China Sea and treatment of [Uighurs](https://www.nytimes.com/interactive/2019/11/16/world/asia/china-xinjiang-documents.html) are all likely to be flashpoints with the new Biden administration, and with administrations to come. And the fundamental technological decoupling between the two powers will continue as well, leaving even less room for cooperation. As relations between the two countries continue their rocky trajectory, there is a very real possibility that a misstep by one or the other will lead to real escalation, and even violence in some instances. But none of this points to the kind of zero-sum, Cold War we saw in the 20th-century, the kind of all-consuming ideological divide that forces the rest of the world to pick sides. There are too many structural barriers to that, and too much prosperity at stake for political leaders in Washington and Beijing to risk. There are plenty of things to be concerned about as we round into 2021—this isn’t one of them.

## 2AC – USIACA

#### No vote until June

AFP 3/29 (“US Senate passes bill aimed at increasing America’s competitiveness with China,” <https://hongkongfp.com/2022/03/29/us-senate-passes-bill-aimed-at-increasing-americas-competitiveness-with-china/>, //pa-ww)

The US Senate voted Monday to greenlight a multibillion-dollar bill aimed at jumpstarting high-tech research and manufacturing, countering China’s growing influence and easing a global shortage of computer chips. The legislation is the upper chamber’s version of the House’s America Competes bill that passed in February. Lawmakers are expected to start negotiations between both parties in the House and Senate to marry the different texts. Senate Majority Leader Chuck Schumer said the long-stalled legislation would be “one of the most important accomplishments of the 117th Congress.” “This bill, for all its provisions, is really about two big things: creating more American jobs and lowering costs for American families,” he told senators. “It will help lower costs by making it easier to produce critical technologies here at home, like semiconductors. It will create more jobs by bringing manufacturing back from overseas.” Schumer and Senate Minority Leader Mitch McConnell have been discussing the contours for launching formal negotiations on the legislation as early as April, and a floor vote in May or June. The House and Senate versions both provide for President Joe Biden’s aim of investing US$52 billion in domestic research and production, marking a win he could trumpet ahead of November’s midterm elections. The 2,900-page House version passed mostly along party lines with Republicans arguing it wasn’t tough enough on China and that it was overly focused on unrelated issues like climate change and social inequality. That means it is destined for a conference committee, where Senate Republicans will have all the leverage since 10 of them will be needed to get the final text back through the upper chamber. Schumer said however the legislation would power a new generation of American innovation. “Whichever nation is the first to master the technologies of tomorrow will reshape the world in its image,” he said on the Senate floor. “America cannot afford to come in second place when it comes to technologies like 5G, AI, quantum computing, semiconductors, bioengineering and so much more.”

#### Won’t Pass – Massive Differences

MEYER and ALEMANY 3/23 (Theodoric and Jacqueline; Washington Post, “Time is running out for a deal on the China competitiveness bill,” <https://www.washingtonpost.com/politics/2022/03/23/time-is-running-out-deal-china-competitiveness-bill/>, //pa-ww)

Congress has tied itself into a Gordian knot over one of President Biden’s top legislative priorities: a bill to bolster American semiconductor manufacturing and help the country compete economically with China. It's Commerce Secretary Gina Raimondo’s job to help cut it — but time is running out. Raimondo is working to help lawmakers reach an agreement, which would give Democrats another achievement in the midterms. She told reporters in January that Congress “can’t wait until April, May” to pass the bill — a timeline that is now impossible to meet. In an interview, Raimondo told The Early she thought the bill could be done by Memorial Day — maybe sooner. “There’s no deadline, per se,” Raimondo said. “We just have stay focused on it and do the work — sit at the table and do the work to reconcile the differences.” “I'm going to work on this and talk to members of Congress every single day until it does pass,” she added. While the bill is a top priority for the White House, Senate Majority Leader Chuck Schumer (D-N.Y.) and House Speaker Nancy Pelosi (D-Calif.) to help improve Democrats' standing ahead of the midterms, the negotiations also serve as a political opportunity for Raimondo. The former Rhode Island governor could burnish her reputation as a leading moderate in the party by showing she can help negotiate a deal with Republicans at a time when bitter partisanship reigns. “One of the most impressive things about Secretary Raimondo is that she is as comfortable, willing and happy to call a progressive member from California as a Republican senator from a deep-red state,” said Scott Mulhauser, who worked as a senior adviser to Raimondo for several months last year before returning to his consulting firm. Some Republicans have praised Raimondo's work trying to hash out a compromise. “Amongst many of the Senate Republican staff that I’ve spoken with on this matter, she has been very helpful,” said Ari Zimmerman, a Republican lobbyist at Brownstein Hyatt Farber Schreck who's lobbied on the bill. “She understands the problem in and out.” But it's still unclear whether a deal will actually come together. A tough deal Congress has been laboring to pass the bill for most of Biden's presidency. The Senate cleared its version in June with 19 Republican voters; the House passed its own bill last month with the support of only a single Republican, Rep. Adam Kinzinger (Ill.). The challenge facing Raimondo and Democratic congressional leaders now is how to strike a deal that keeps at least 10 Senate Republicans on board and still wins the support of wary House Democrats. That task grows harder each day as the midterms approach and Republicans lose any incentive to make compromises that would allow for passage of a bill Democrats could tout ahead of November's elections. Raimondo insists there is a deal to be had and argued that there’s already bipartisan agreement on “the bones of the bill” — a $52 billion program to combat a global shortage of computer chips by subsidizing manufacturing in the United States. But lawmakers are at odds over provisions that fall “outside of the core innovation package,” as she put it, such as climate change, financial services and human trafficking. The biggest gap between the two bills is on trade, according to Raimondo as well as several lobbyists tracking the legislation. “That’s really where the two sides are the farthest apart,” said Brian Pomper, a Democratic lobbyist at Akin Gump Strauss Hauer & Feld who has lobbied on the bill. “And, I mean, they are universes apart.” Republicans and Democrats are preparing to hash out the differences between the two bills in a conference committee. If negotiations falter, though, Pomper said lawmakers might push to scrap the trade provisions and pass a more limited bill. “If you really get jammed up on the trade title, I think you’re going to see some members starting to say, ‘Well, why don’t we just ditch the trade title? And let’s do the rest of this bill, which is going to be a lot easier to figure out,” he said. Not giving up without a fight But stripping out the trade provisions could alienate Senate Republicans whose votes Democrats need to overcome a filibuster. The trade language in the Senate bill “was the linchpin that was needed” to pass it last year, said Clete Willems, a former trade negotiator in Donald Trump’s White House who is now a lobbyist tracking the bill. “So I think it’s going to be ultimately included.” House Democrats who spent months pushing to pass their version of the bill, meanwhile, aren't likely to give up without a fight. “The things that we're proposing are good for American manufacturing,” said Rep. Earl Blumenauer (D-Ore.), who backed the trade provisions in the House bill. “They're good for the American consumer. Many of my Republican friends are violently opposed to giving special concessions to China. I wouldn't think this would be a heavy lift.” The China bill, Blumenauer added, is likely the only chance to pass these trade measures before the midterms. “This is one of the few trains leaving the station,” he said. Flying in Raimondo will get some help lobbying for the legislation this week from the Semiconductor Industry Association. The trade group's members — who would benefit from the subsidies to the industry, as Biden pointed out in his State of the Union earlier this month — are in town this week and will meet with Raimondo, U.S. Trade Representative Katherine Tai and lawmakers.

#### Won’t Pass – Corporate Opposition and Ukraine

BADE 3/7 (Gavin; Politico, “White House split delays plans for investment controls on China,” <https://www.politico.com/news/2022/03/07/white-house-investment-rules-china-00014496>, //pa-ww)

The White House says those discussions are ongoing, but the delay has frustrated China hawks on the Review Commission, which has typically advocated a hard line on Beijing, and on Capitol Hill, where lawmakers are considering similar legislation to review U.S. supply chains in China as part of a broad economic competitiveness package. Now, lawmakers are concerned Russia’s invasion of Ukraine will further distract congressional efforts and White House deliberations alike. “We should have acted on this earlier anyway, but now something else has intervened,” said Sen. John Cornyn (R-Texas), who authored legislation to increase oversight of supply chains in China with Sen. Bob Casey (D-Penn.). “And something else will intervene [again] if we don’t get to it.” Part of the delay, the lawmakers and industry officials say, may be due to the White House waiting to see how Congress handles Cornyn and Casey’s legislation, which would set up a federal commission to review supply chains that run through China. The bill has been delayed for more than a year amid opposition from corporate groups, who have argued it is overly broad, but it is now under consideration as part of Congress’ broad China economic competitiveness legislation, slated to be finalized this spring. “The administration has probably been watching the chances of congressional passage of an outbound investment review provision,” said David Thomas, senior vice president at the US-China Business Council, which opposes the provision included in the House’s version of the legislation. “More broadly, there’s a lot more political momentum this time behind the [China competitiveness bills] and it’s my sense that the administration has been pushing more in recent months for passage.” Since last year, the White House has pressured lawmakers to approve the broad China competitiveness legislation which is anchored by a $52 billion semiconductor manufacturing fund prioritized by Biden and congressional leaders. But the administration has not taken a position on whether the Casey-Cornyn legislation should be a part of that package or considered separately. Even if Casey and Cornyn’s bill is approved, trade veterans say that executive action from Biden may still be necessary to address concerns about American banks funding Chinese tech development. As written, the bill would focus more on supply-chain security, such as U.S. firms building factories or entering joint ventures in the medical, defense or energy industries. But it would do little to monitor the financial flows into Chinese technology firms that the White House would likely target with executive action. Though no executive orders have been finalized, one of the industry officials with knowledge of administration discussions said that eventual action will likely cover American banks, mutual funds and other financial institutions investing in Chinese semiconductors, artificial intelligence, facial recognition and other surveillance areas. It would likely derive its authority from the International Emergency Economic Powers Act, which gives the president broad authority to limit trade in economic emergencies, and could also include export controls to limit the shipment of the technologies themselves, in addition to funding flows. But the timing of any action remains unclear. The second industry official with knowledge of White House talks said the Ukraine invasion has taken much of the time of national security officials such as Sullivan and those at the State and Defense departments, which would also have a role in any eventual executive order. Even when the issue returns to the front burner, Treasury and Commerce’s opposition may be tough to overrule, given that they are likely to have leading roles in carrying out new export or investment controls.

#### ACA would worsen the chip shortage and undermine global scientific coop

YI 3/30 (Wang; Global Times, “US COMPETES Act is poisonous for global technological development,” <https://www.globaltimes.cn/page/202203/1257227.shtml>, //pa-ww)

After the bill was proposed, there were comments in US media outlets that if the bill was implemented, it would be the largest action by the US government to deal with China in the intensifying technology competition. But the bill also has two serious problems: double standards and danger to global technology development. This bill, which is full of Cold War mentality, poses the risk of further splitting global scientific and technological cooperation and further disrupting the global industrial chain. As the world is still suffering a chip supply crunch due to COVID-19 pandemic impacts and geopolitical gaming factors, the global chip industry is facing a restructure. Once taking effect, the so-called COMPETES Act will further deepen the gap between China and US technology research and industries, which in turn will worsen the global chip shortage. The US is extremely anxious about the decline of its relative advantage in the high-tech field, but driven by a twisted political agenda aimed at confronting China, there is little chance for it to achieve the goal of reviving technological innovation by passing the legislation. If the US increases subsidies and develops technology to attract the return of the manufacturing, while continuing to force its allies to create a "China free" technology circle, then the world's technology field will inevitably be divided into two. That might be ideal for radical anti-China politicians in Washington, but for the business community in the US and around the world, that's a dangerous and costly path forward.

#### The bill won’t solve for U.S. competitiveness and case turns the disad

DONNELLY 2/4 (John M.; Roll Call, “Cost to rebuild U.S. semiconductor manufacturing will keep growing,” <https://rollcall.com/2022/02/04/cost-to-rebuild-u-s-semiconductor-manufacturing-will-keep-growing/>, //pa-ww)

As Washington debates spending $52 billion to start regaining America's former role as a leading semiconductor manufacturer, experts say the public and private cost over the next two decades may exceed 10 times that much — and some worry such spending may still not achieve the goal. On Friday, the House passed the measure to appropriate the $52 billion in subsidies over five years, largely for grants to catalyze private companies’ construction on U.S. soil of semiconductor fabrication factories, which are known as fabs. The Senate passed a similar bill last year. With President Joe Biden supporting the measure, some version of it may soon become law. Some conservatives take issue with elements of the bill’s semiconductor section and with other parts of the nearly 3,000-page House version. And others reject the very notion of such massive aid to private industry. But most members of Congress believe the spending is needed to ensure that the United States is not overly reliant on vulnerable overseas supplies of components that are nearly as critical as energy to both the global economy and U.S. national security. The debate occurs amid a semiconductor shortage that is driving up inflation. It also comes as worries grow that Taiwan, where 92 percent of the world’s high-end chips are made, could be invaded by China or that even a lesser crisis in that region could hamstring supplies that everyone from the Pentagon to General Motors relies upon. But the long-term financial commitment that experts say would need to follow the $52 billion appropriation is rarely discussed. Over the next two decades, the spending required from the public and private sectors to build and operate enough fabs to give America a reliable supply for most of its needs will probably exceed $500 billion, including the initial $52 billion, semiconductor policy experts at the Potomac Institute for Policy Studies told CQ Roll Call this week. Other experts said that estimate is reasonable. Still, many analysts emphasize that the government money must help companies defray not just the cost of building new fabs — which is the current focus — but also the more challenging part: the cost of operating them. Otherwise, they say, the scores of billions of dollars may be misspent. “In many cases, the government throws money at something, and then it doesn't solve the problem, because the money was not allocated to the places it needed to be,” said Bryan Clark, a Hudson Institute senior fellow who performs studies on microelectronics for the secretary of Defense. “This is just going to be another example of that.” Wrong approach? Three decades ago, Americans built nearly half of the world’s most modern chips but now produce only about 12 percent, according to industry figures. Americans still lead the field in designing chips. The legislation that Congress is weighing to begin to regain the old share of the market would finance mostly the building of fabs with grants of up to $3 billion per project. But U.S. companies have never lacked money to build fabs, Clark said. What drove the companies out of the production business in the first place was the high cost of operating such facilities compared to competitors abroad, who had the benefit of not only government subsidies but also in many cases lower labor, tax and regulatory compliance costs. The funds needed for constructing fabs could always be bankrolled by loans or bonds, Clark said — but not so with operating expenses. He favors government incentives such as tax breaks to support the cost of running a fab. Others agree that sustaining the fabs will be at least as important as building them. “The reason American companies moved offshore last time is because we were not price competitive,” said John Nichols, a senior fellow at the Potomac Institute for Policy Studies. “So without sustained government investment and subsidies to keep the industry price-competitive internationally, 10 years from now, when we’ve built all the fabs, we're going to have the same problems if it's too costly to do this stuff in the United St

ates.” Private sector’s role The government spending must not only be ongoing and focused on sustaining the fabs that are built, the experts said, but it also must be backed up by at least as much private money. “The only way this will work is if this government money spawns co-investment by industry,” said Michael Fritze, who is also a senior fellow at the Potomac Institute for Policy Studies. As Congress debated the chips funding, Intel Corp. announced this month a $20 billion investment to build a new chip-manufacturing center near Columbus, Ohio. The Semiconductor Industry Association of America believes that pattern will recur. They say a $50 billion investment from the federal government in chip manufacturing would create 10 fabs that would not otherwise be built and would trigger some $279 billion in additional private sector investment. The group also says such federal support would create an annual average of 185,000 temporary or permanent American jobs and would add $24.6 billion per year to the U.S. economy. “Leaders in Washington have a historic opportunity to reinforce domestic chip production and innovation for many years to come,” Dan Rosso, a spokesman for the association, told CQ Roll Call. Chips are up? The pending spending bills would appropriate funds first authorized in the so-called CHIPS Act, which was part of the fiscal 2021 National Defense Authorization Act. The likelihood of further government support will affect how much of the total cost is borne by industry, said Mark Lewis, a former top Pentagon official who is now executive director of the Emerging Technologies Institute at the National Defense Industrial Association. “The next set of decisions to be made by Congress on how much money to actually put behind the CHIPS legislation will send a signal on how serious we are in recapturing microelectronics production, and it will also shape both government and industry investment strategies,” Lewis said. Whether all the spending makes America free of foreign supplies for most of its chips will also hinge largely on U.S. corporations’ ability to attract and retain a sufficiently large number of people with the arcane skills to operate impeccably sanitary and highly specialized equipment. “Without qualified candidates to run the fabs, it doesn't matter what we invest in the facilities,” said Jennifer Buss, CEO of the Potomac Institute for Policy Studies. “They won’t be operational.” Competing for that talent will not be easy. The looming splurge of U.S. spending will create a response from other countries, and that will up the bidding for this small pool of talent. Those competitors include some countries that have made chip manufacturing a national mission: allies such as Taiwan, South Korea, Japan and the Netherlands, plus China. Cost of reliance While $500 billion is a lot of money by anyone’s measure, that level of public and private spending is standard in the global semiconductor field. Worldwide sales of chips were more than $500 billion in 2021 alone, according to industry estimates. And in just the last several years, China, South Korea, Japan and the European Union have announced about $260 billion in government spending in the next decade for their companies, according to the Semiconductor Industry Association. Appropriations to rebuild U.S. chip manufacturing would be well spent, if tailored in the right way, many experts said. The current chip shortage and its dire effects could foreshadow a worse crisis, as the growing number of devices connected to the web and the emergence of electric cars and other new products require even more — and more sophisticated — semiconductors. The cost of restoring lost American chip manufacturing must also be weighed against the wealth that would be lost from a cutoff or cutback in semiconductor supplies. Such a crisis could be worse than the current shortages, and it could be triggered by anything from a climate catastrophe to another pandemic to a war.

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## CASE

#### Tribes doesn’t make sense either. They literally aren’t going to invoke sovereign immunity because they haven’t

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Under the Hatch-Waxman and America Invents Acts, Congress has established a system for judicial and administrative review of prescription-drug patents that balances exclusive rights for patent holders and the entry of generic competitors. Threatening this balance, the pharmaceutical company Allergan recently transferred prescription drug patents to the Saint Regis Mohawk Tribe, a federally recognized Indian tribe. Because tribal sovereign immunity limits the jurisdiction of courts and other adjudicatory bodies to hear cases involving tribal interests, such actions by brand-name pharmaceutical companies may prevent generic companies and other parties from invalidating patents, likely leading to higher drug prices. This Essay proposes an option to discourage such transactions: an antitrust suit, which would not require the joinder of all co-conspirators and could thereby sidestep sovereign immunity. The Allergan-Tribe transaction improperly increases the probability that Allergan's patent is upheld beyond what was envisioned by Congress's original grant of market power. To evaluate such transactions, this Essay argues that courts should adopt the permissive "no economic sense" test: when an agreement makes no economic sense but for its anticompetitive purpose, patent assignments to a sovereign actor are anticompetitive. This test would prevent the naked lease of sovereign immunity such as the present Allergan-Tribe transaction, while still allowing for productive collaborations between private parties, and sovereign states or tribes. The Essay concludes, however, that antitrust law alone cannot address all misuses of sovereign immunity for private gain; Congress must also take a broader approach to address the lack of tribal economic opportunities. On September 8, 2017, the global pharmaceutical company Allergan announced that it had transferred its patents for its top-selling drug Restasis, a prescription drug for chronic dry eye, to the Saint Regis Mohawk Tribe, a federally recognized Indian tribe.' In its press release, Allergan referenced both pending patent litigation in the federal courts and ongoing inter partes review (IPR) proceedings2 at the Patent Trial and Appeal Board (PTAB), claiming that the Tribe would not invoke its sovereign immunity in the former, but would file a motion to dismiss in the latter.3 Under the terms of the agreement, the Tribe received $13.75 million upon execution and $15 million in annual royalties in exchange for holding the patents and granting an exclusive license to Allergan. 4 This announcement led to immediate outcry and drew the ire of members of Congress.6 Missouri Senator Claire McCaskill has drafted a bill to limit tribal sovereign immunity before the PTAB. 7 The district court judge in the ongoing patent litigation asked if the transaction was a "sham,"" and at least one scholar of patent law has argued that - since Allergan retains de facto control of the pa tents -Allergan should be regarded as the legal owner.9 Underpinning these critiques is the worry that Allergan's "sale-leaseback" will allow the company to maintain a dominant market position to the detriment of competitors and consumers. These concerns are well-founded. In the short term, such a transfer could allow Allergan to avoid invalidation of its patents through the PTAB's IPR process, thereby increasing the probabilistic value of its patents beyond what was envisioned by the initial grant of exclusivity. In the long term, this transaction undermines the viability of the IPR system itself, blunting a congressionally created tool to invalidate weak patents. Furthermore, even though the Tribe did not invoke sovereign immunity in litigation at the trial court level, others following Allergan's lead might choose to do so, potentially insulating patents from review even in the judicial system. Ultimately, if upheld, these kinds of transactions make it more likely that brand-name firms maintain their market exclusivity, leading to higher drug prices and harming consumers.

## Single Payer

#### Every single payer system proves—solves nothing

Pipes 14 (Sally Pipes is president, CEO, and Taube Fellow in Health Care Studies at the Pacific Research Institute, “ally Pipes: Wait times and single-payer health care” http://www.ocregister.com/2014/08/04/sally-pipes-wait-times-and-single-payer-health-care/)

The Veterans Affairs scandal may seem like it can’t get any worse – yet bad news continues to mount. An audit of the VA hospital system has revealed that over 57,000 patients have been forced to wait at least 90 days for an appointment. More than 63,000 patients in the past decade have requested appointments that were never even scheduled. And many have died while waiting for care. These are the natural consequences of a government-run, single-payer health care system – whether it’s in Phoenix or a foreign nation, like Canada or the United Kingdom. Single-payer’s champions claim that the system can restrain health costs by reducing administrative spending. One payer theoretically has more market power to demand better prices – and can streamline spending on claims processing and the like that’s currently handled by insurers. But single-payer systems are prone to cost overruns. Between 2007 and 2012, the VA’s budget grew faster than its patient population – a 76 percent bump in spending, versus a 13 percent increase in the number of patients. Yet the system is still cash-strapped. The Congressional Budget Office estimates that the VA is staring at a 75 percent budget shortfall. The same is true of single-payer systems abroad. The one in Canada – the country of my birth – is $537 billion in the red. Taiwan’s has had to borrow heavily to cover excess costs. Single-payer administrators effectively have one option for containing ballooning costs – rationing. They artificially restrict access to drugs and services. Patients experience those restrictions in the form of long waits – or outright denials of care. This causal chain played out to dangerous effect in the VA. The Phoenix facility at the heart of the scandal stashed at least 1,600 vets on secret waiting lists. About 7,000 were backlogged at facilities in Columbia, South Carolina, and Augusta, Georgia. Forty-five percent of vets suffering from mental health issues – among the most serious threats to their post-combat well-being – have had to wait 14 days or more just to get an appointment. In one particularly egregious case, a soldier who had served a 10-month tour in Iraq came home only to face a four-month wait for a mental health appointment at a VA hospital in South Carolina. These delays in treatment are even worse in single-payer systems abroad. According to the latest research from the Fraser Institute, a think tank, the average Canadian has to wait 18 weeks between referral from a general practitioner and receipt of treatment from a specialist. Those north of the border are collectively waiting for more than 928,000 procedures. Nearly 3 million people are on waiting lists in the United Kingdom. Rationing doesn’t just come in the form of restricted access to doctors. System administrators also routinely deny coverage for cutting-edge drugs and treatments. The VA system maintains a restrictive drug formulary that covers only about a third of the medicines available to Medicare patients. Every year, the United Kingdom’s National Health Service denies about 52,000 patients coverage for basic services like cataract operations and varicose veins treatment. Single-payer rationing also exerts a huge human toll. Consider the case of Edward Laird, a 76-year-old Navy veteran. He faced an astonishing two-year delay to get a biopsy for cancerous blemishes that ultimately cost him half his nose. For 71-year-old veteran Thomas Breen, a month-long wait to get treated for a urinary tract infection proved fatal. No less than 18 veterans at the now-infamous Phoenix facility died before getting care. It’s hard to square these realities with the conclusions of the VA’s defenders, like Princeton economist Paul Krugman, who has described the Veterans Health Administration as “our little island of socialized medicine in the United States. And it does very well.” In Canada, long wait times have played a role in the deaths of 44,200 female patients over the last two decades. More than 8,600 Australians in that country’s single payer system have died while on waiting lists. Over the last four years, more than 50,000 British patients have had to wait two months or more for chemotherapy, radiotherapy or cancer surgery. The VA scandal is far from over. As the full extent of the agency’s failure comes into focus, the lesson for national policymakers should be clear – single-payer health care is disastrous. Long, dangerous wait times are inevitabilities. They aren’t a bug of single-payer – they’re a feature.

## DOJ Trade Off DA

#### Extend Link Turn, we free up resources by making it per se illegal. Squo means DOJ has to expend resources trying to prove anti-competitive effects if they want to bring someone to court which means that we solve best AND better than the CP since it would leave squo resource practices in place –

Michael Kades, July 13, 2021, the director of Markets and Competition Policy at the Washington Center for Equitable Growth, Michael worked as antitrust counsel for Sen. Amy Klobuchar (D-MN), the ranking member on the Senate Judiciary Subcommittee on Antitrust, Competition Policy and Consumer Rights, where he led efforts to reform antitrust laws. Previously, he spent 20 years investigating and litigating some of the most significant antitrust actions as an attorney at the Federal Trade Commission. “A Canary in the Coal Mine for the Failure of U.S. Competition Law: Competition Problems in Prescription Drug Market” https://equitablegrowth.org/a-canary-in-the-coal-mine-for-the-failure-of-u-s-competition-law-competition-problems-in-prescription-drug-market///JK

Pay-for-delay patent settlements

Even when antitrust enforcement has had success, it is incomplete. A pay-for-delay patent settlement occurs when a branded company pays the generic or biosimilar company to delay launching its competitive product. The settlement eliminates the potential for competition. Both the branded and generic company profit at the expense of consumers.

The antitrust battle over these settlements has raged for roughly two decades. In a series of decisions that began in 2003, various courts concluded that this practice was acceptable.25 In these courts’ view, the fact that the branded company’s patent might exclude the generic meant that the branded company could pay the generic not to compete for any period of time until the patent expired.

These rulings had a devastating impact on generic competition. The number of potential pay-for-delay deals with significant payments increased from zero in fiscal year 2004 to a high of 33 in fiscal year 2012.26 The deals increased prescription drug costs by $63 billion.27

In 2013, in the Androgel case (FTC v. Actavis), the Supreme Court rejected the lenient view that patent holders could simply pay potential infringers to stay off the market. According to the Supreme Court, an agreement in which the branded and generic companies eliminate potential competition and share the resulting monopoly profits likely violates the antitrust laws, absent some justification.28 The Supreme Court’s decision has limited pay-for-delay deals. In fiscal year 2017, the most recent year of reported data, the number of potential pay-for-delay deals with significant payments fell to three.29

That success has been incomplete, and it overlooks the cost of enforcement. The Supreme Court approach requires a case-by-case analysis of a practice that virtually always is anticompetitive. That allows companies to find new ways to hide compensation or offer a plethora of alternative justifications for their conduct. Based on the past mistakes and some open hostility to the Supreme Court’s decision, courts could accept one of these defenses and create a costly loophole.

Further, the approach is resource intensive. Indeed, the FTC resolved the Androgel case itself almost 6 years after the Supreme Court decision allowing the case to go forward and more than a decade after the case was filed. The FTC continues to litigate multiple cases against the same parties over the same product.30

Failure of antitrust law

Anticompetitive conduct in prescription drug markets has been occurring for decades and has flourished despite the Federal Trade Commission having devoted substantial resources to trying to stop the conduct. It regularly litigates to judgment to stop egregious anticompetitive conduct with only limited success. The obstacles to successful enforcement are likely to increase because the Supreme Court has taken away the FTC’s ability to seek monetary remedies.

We are in this situation because “antitrust enforcement faces a serious deterrence problem, if not a crisis.”31 Judicial decisions have contributed to this problem. They “have thrown up inappropriate hurdles that limit the practical scope of the antitrust laws’ application to anticompetitive exclusionary conduct, including monopolization, and to anticompetitive mergers.”32 These developments make it less, not more, likely that antitrust law will condemn harmful conduct.

Hostility to direct evidence of market power

In most antitrust cases, the plaintiff must prove that the defendant had market or monopoly power. A plaintiff can infer it by proving the relevant market and establishing that the defendant has a high market share. The alternative is to prove the actual anticompetitive effect of the conduct—such as higher prices, lower quality, and lower output.33 As the Supreme Court explains, “proof of actual detrimental effects, such as a reduction of output can obviate the need for an inquiry into market power, which is but a surrogate for detrimental effects.”34

Courts, however, increasingly shy away from direct effects evidence, making plaintiffs go through the often pedantic process of defining markets, particularly in pharmaceutical cases. Invariably, the impact of delaying or limiting competition is obvious. Delaying a generic or biosimilar competitor prevents prices from falling. That should end the market power inquiry. Courts, however, reject the obvious direct evidence for the less reliable market definition evidence.

#### Zero capabilities for conflict, nukes won’t get used, and domestic Chinese constraints check conflict or international leadership

Swaine, 21

(Michael; 4/21/21; PhD in Government from Harvard University, director of the East Asia program at the Quincy Institute; "China Doesn’t Pose an Existential Threat for America," https://foreignpolicy.com/2021/04/21/china-existential-threat-america/)

There is no doubt that Beijing’s behavior in many areas challenges existing U.S. and allied interests and democratic values. Particularly under Xi Jinping, China has used its greater economic and military power to intimidate rival claimants in territorial disputes and punish nations that make statements or take what Beijing views as threatening or insulting actions. It has engaged in extensive commercial hacking and theft of technologies and favors military intimidation over dialogue in dealing with Taiwan. And it has employed draconian, repressive policies in Tibet and Xinjiang and suppressed democratic freedoms in Hong Kong. This deeply troubling behavior certainly requires a strong, concerted response from the United States and other nations. But to be effective, such a response also requires an accurate assessment of China’s future impact on the United States and the world. And in this regard, it is extremely counterproductive to U.S. interests to assert or even imply, as many now do, that the above Chinese actions constitute an all-of-society, existential threat to the United States, the West, and ultimately the entire world, thereby justifying a Cold War-style, zero-sum containment stance toward Beijing. Such an extreme stance stifles debate and the search for more positive-sum policy outcomes while leading to the usual calls for major increases in defense spending. In fact, there isn’t much actual evidence to support the notion of China as an existential threat. That does not mean that China is not a threat in some areas, but Washington needs to approach this issue based on the facts, not dangerous rhetoric. Unfortunately, right-sizing the challenges that China poses seems to be an impossible task for Washington. In the most basic, literal sense, an existential threat means a threat to the physical existence of the nation through the possession of an ability and intent to exterminate the U.S. population, presumably via the use of highly lethal nuclear, chemical, or biological weapons. A less conventional understanding of the term posits the radical erosion or ending of U.S. prosperity and freedoms through economic, political, ideational, and military pressure, thereby in essence destroying the basis for the American way of life. Any threats that fall below these two definitions do not convey what is meant by the word “existential.” As a military power, China has no ability to destroy the United States without destroying itself. China’s nuclear capabilities are far below those of the United States, and its conventional military, while regionally potentially powerful, has a fraction of the budget of that of the United States. Some argue that China could militarily push the United States out of Asia and dominate that region, denying the country air and naval access and hence support for critical allies. This would presumably have an existential impact by virtue of the supposedly critical importance of that region to the stability and prosperity of the United States. Yet there are no signs that Washington is losing either the will or the capacity to remain a major military actor in the region and one closely connected to major Asian allies, which are themselves opposed to China dominating the region. In reality, the greater danger in Asia is that Washington could so militarize its response to China that its actions and policies become repugnant even to U.S. allies. This leaves the unconventional threats. Here they are presumably twofold: economic and technological, and in the realm of ideas and influence operations within the United States and other Western countries, including the export of China’s so-called “model” of authoritarian rule to the rest of the world. The former threats would presumably consist of China attaining a level of total superiority over both economic and technological levers of influence globally and with regard to the United States (perhaps combined with a successful military blocking of U.S. sea lines of communication) that would so impoverish the country as to threaten its existence as a stable and prosperous democracy and bring it under Chinese control. Presumably, the specific basis of such leverage would consist of near-absolute global Chinese dominance over both trade and investment relations and supply chains with the United States and other countries and over all the key technologies driving future growth and military capabilities. It is virtually inconceivable