# 1AC

### Adv 1 is Unification

#### Dual enforcement authority between the DoJ and FTC creates havoc among antitrust rulings now—it ensures conflicting regulations and dissent which produces confusion and inefficiencies

Cox, 20

(Alyson M. Cox, JD from Notre Dame Law School, managing articles editor at Notre Dame Law School, “From Humphrey’s Executor to Seila Law: Ending Dual Federal Antitrust Authority,” 96 Notre Dame L. Rev. 395 (2020) NL)

In the summer of 2019, the Department of Justice and Federal Trade Commission announced that they would be dividing the investigations into four of the biggest American tech firms, with the DOJ investigating Google and Apple and the FTC investigating Amazon and Facebook. Senator Mike Lee was among the decision's many critics; he argued that the "splitting of this tech antitrust review across two federal agencies, despite the many similar competition issues that will be investigated, illustrates the absurdity of having two federal agencies handling civil antitrust enforcement."1 But even this "brokered peace didn't last long," 2 and it soon became clear that the DOJ and FTC would be conducting overlapping investigations.3 The DOJ and FTC have shared civil antitrust enforcement since the early 1900s,4 and although their authority is not identical, "the core of the agencies' jurisdiction is congruent." 5 This dual enforcement structure has been continuously challenged for the better half of the last century by both academics and government actors,6 although conventional wisdom holds that elimination of either agency's civil antitrust authority would be politically costly.7 There are well-recognized efficiency costs to the dual enforcement structure, including the expensive and time-consuming merger-clearance process. 8 The two agencies often compete in "turf wars" over cases,9 and have even filed amicus briefs against each other in federal court,10 raising serious questions of government efficiency and procedural and substantive fairness. But in addition to the well-worn complaints about efficiency and fairness, there are significant, mounting reasons to subject this dual enforce-ment authority to constitutional evaluation, especially in light of recent doctrinal shifts regarding the constitutionality of independent agencies. Last term, the Supreme Court held in Seila Law that the independence of the Consumer Financial Protection Bureau (CFPB) was an unconstitutional violation of the separation of powers, shrinking Humphrey's Executor down to a very thin, very wobbly protection of the FTC's constitutionality. Aggrieved parties are already challenging FTC actions on a range of constitutional grounds,11 and the majority opinion in Seila Law provides a roadmap for doing so. This Note catalogues and proposes solutions to both the traditional concerns of efficiency and fairness and the modern constitutional problems posed by the current dual enforcement structure. Part I will compare the two antitrust agencies on the basis of their structures, accountability, statutory authority, and enforcement procedures, as well as evaluate potential concerns with vesting either agency with the sole authority to enforce civil antitrust laws. Part II will evaluate the perils of the current dual enforcement structure, exploring both the traditional arguments about efficiency and fairness and the modern constitutional challenges. Part III will evaluate potential legislative solutions to the problem of dual antitrust enforcement authority in the United States. The constitutionality of the FTC's status as an independent agency is again under serious question; it is time for Congress to seriously rethink and restructure civil antitrust authority accordingly.

#### Specifically, merger clearance delays and different procedural and substantive standards ensure regulatory uncertainty

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1. Merger Clearance Delays The HSR Act only allots thirty days post-notification for merger review, but the DOJ and FTC often take much of, or more than, the thirty days just to decide which agency is going to investigate a merger. 122 The Antitrust Modernization Commission (AMC), which studied the problem of dual enforcement in the mid-2000s, argued that this inefficiency places "significant burdens on companies with time-sensitive transactions." 12 3 When the agencies fail to come to a timely resolution, they frequently initiate second requests that are expensive for parties to comply with. 124 This is because, prior to clearance, staffers "cannot reach out either to the merging companies or third parties," and they frequently need more time than what is left over of the thirty days to complete their review. 125 Unlike disputes between other executive agencies, there is no way to quickly resolve these disputes through the chain of command because the FTC is not accountable to the President. Assistant Attorney General Makan Delrahim has stated that one standstill was solved with a coin toss. 126 Axon Enterprises called the clearance process an "uncodified black box" that can have "real consequences" for parties. 127 Such turf wars are a waste of taxpay ers' resources and frequently shift considerable burdens to parties under investigation. 2. Different Procedural Standards Companies often feel that they are treated differently depending on whether their case is assigned to the DOJ or the FTC. 128 These perceptions primarily stem from the fact that the DOJ and FTC pursue different injunctive relief in federal court.1 2 9 In the case of anticompetitive mergers, the DOJ pursues preliminary and permanent injunctions, which give parties finality.130 The FTC, however, pursues only preliminary injunctions; regardless of the outcome of the injunction, the FTC then proceeds through a lengthy administrative process for permanent relief.131 The AMC noted that the "FTC's ability to continue a merger case in administrative litigation ... may lead companies whose transactions are investigated by the FTC to feel greater pressure to settle a matter than if they had been investigated by the DOJ."132 As a result, the agencies' procedural differences "can undermine the public's confidence" in antitrust authorities. 133 3. Different Substantive Standards A third commonly made argument about the undesirability of the dual enforcement structure is the uncertainty and cost to businesses seeking to comply with both the DOJ and FTC when they apply different substantive standards. 134 The two agencies frequently disagree on legal standards, as evidenced by the amicus brief filed by the DOJ against the FTC in the Qualcomm litigation, 135 as well as broader antitrust policy. 136 Is it fair to companies that there is not always a unified, knowable antitrust position of the United States? The problem of differential substantive standards in dual enforcement looms large in the current debates about antitrust enforcement and big tech, especially in the current cases of Facebook, Google, Amazon, and Apple.1 3 7 These overlapping investigations raise the possibility that the DOJ and FTC might not only present different litigating positions of the United States on certain topics, but the agencies might actually enforce different substantive standards on shared plaintiffs. When both the FTC and the DOJ, in addition to states and congressional committees, are inquiring into internet platforms, companies "'trying to make decisions with some level of comfort and certainty' are finding out that there is little of either." 138 The Qualcomm litigation is further evidence of the undesirability of competing antitrust policy visions. This litigation arose out of the fundamental disagreements between the FTC and DOJ on the relationship between antitrust and intellectual property law. Qualcomm sells chips used in modern cellphones to manufacturers and licenses patents which are essential to certain cellphone technology standards. 139 The FTC sued Qualcomm, arguing that because the company's chips were the standard for cellphones, the company had a duty to makes its chips available for licensing.140 The DOJ disagreed, arguing in its amicus brief against the FTC that Qualcomm's refusal to license was justified by its patents. 141 This conflict, if the FTC were not independent, would normally have been resolved through the Executive Branch's interagency dispute resolution process. Instead, the conflict had to be litigated, at the expense of the party trying to compete in the international market and comply with American antitrust law.

#### That uncertainty ruins tech companies—tanks investment and R&D necessary for effective innovation

McGinnis and Sun 21, John O. McGinnis is the George C. Dix Professor in Constitutional Law at Northwestern Pritzker School of Law. McGinnis is a panelist called on to decide WTO disputes and graduate of Harvard Law School, Linda Sun is an intellectual property lawyer at Wilmerhale and former editor in chief of Northwestern Journal of Technology and Intellectual Property during her time at Northwestern Pritzker School of Law, “Unifying Antitrust Enforcement for the Digital Age”, 78 Wash. & Lee L. Rev. 305, 2021

Thus, dual enforcement has greater risks than ever before, both because disagreement is more likely and costs of uncertainty are greater. This subpart outlines this potential for uncertainty in a variety of areas of antitrust doctrine. In fact, the risk is not just potential. The DOJ and FTC already disagree on the important issue of how to regulate SEPs, creating uncertainty in a growing industry worth billions of dollars.46 The agencies are additionally fighting over who should take the lead in regulating high tech, resulting in divergent investigations when antitrust analysis requires consideration of the entire competitive market to reach sound conclusions. 47 1. The Need for Certainty in Antitrust Regulation of Technology

A unified approach to antitrust regulation is especially important when it comes to the technology industry for three reasons. First, the rapidly growing technology industry is at the center of the U.S. economy: in 2018, the internet sector accounted for $2.1 trillion of the economy and 10 percent of the GDP. 48 Uncertainty about antitrust rules created by dual enforcement hinders economic growth.

Second, technological industries are especially sensitive to shifts in antitrust policy because antitrust actions can change the trajectory of fast-changing industries. For instance, the DOd's antitrust enforcement action against the Bell System broke up the monopoly in telephony. 49 One court later summarized the effect as "an unprecedented flowering of innovation" in the telecom industry.50 Agency antitrust action also played a large role in the growth of software, browser, and web company competition. 5 1 In anticipation of a Justice Department antitrust suit, 52 IBM unbundled its software and hardware products in the 1960s,53 dramatically changing the software market. Nearly overnight, software went from a typically free good to a commercial product.54 Governmental antitrust enforcement is additionally credited for Microsoft's 1997 investment in its rival company Apple, which saved the then-nascent company from the brink of bankruptcy. 55 Microsoft likely acted in self-preservation because it faced antitrust scrutiny that came to a head in a DOJ suit the year after.56 The Microsoft settlement itself is "credited with giving web companies like Google-and browsers like Google Chrome . . . space to grow." 57 These actions changed the technological landscape, and future antitrust decisions regarding technology companies will have just as significant of an impact, if not more.

Moreover, antitrust policy is very important to the research and development that is the heart of innovation in tech, particularly as more research and development has moved from the public sector to the private sector.58 Private companies are affected more directly by antitrust policies. 59 Even the financing of technology is dependent on antitrust law. Today, as discussed in more detail below,60 the primary reason a tech start-up receives funding from investors is its acquisition potential; merger and acquisition policies play a significant role.61 Once again, certainty here is important for investors, and possible and actual conflicts between DOJ and the FTC reduce certainty.

Third, a unified approach to antitrust has become more important because the antitrust issues affecting tech are particularly complex; it is difficult to determine how best to apply antitrust law to emerging technologies. 62 This challenge makes it more likely that DOJ and the FTC will proceed on different theories, increasing uncertainty. For instance, antitrust scholars and regulators have struggled to apply the traditional small but significant non-transitory increase in prices (SSNIP) test to zero-price tech markets.6 3 The SSNIP test, used by both the FTC and DOJ, defines a relevant antitrust market as the "smallest grouping of products for which a hypothetical monopolist could profitably impose a 5% price increase." 64 However, many technology platforms offer their products at no monetary cost to customers. The lack of measurable price renders the SSNIP test difficult to operationalize. 65 This complexity makes it more likely that the DOJ and the FTC will apply the test differently, resulting in uneven and unfair outcomes. SSNIP is only one of many areas of debate regarding how antitrust is to be applied to technology. Technology has raised questions regarding whether increased prices or decreased output is still a viable measure of monopoly. As an example, Facebook has not raised prices or restricted output since its founding, despite plausible claims that it dominates social media.66 While dominant platform companies like Amazon have been accused of levying monopoly power,67 others claim that platform giants and their house brands actually keep prices low. 68

Even defining the market of technology companies raises novel conundrums. To illustrate, Google has a very large share in the market for horizontal search (searches across the internet), but not in general search: users often turn to specialized websites, such as eBay or Amazon, for product searches. 69 Even if horizontal search is the defining market, Google's large share does not necessarily beget monopoly power. Consumers can easily switch between search engines and spend most of their time on websites, which compete with search engines for advertising revenue.70 Addressing these complex issues requires careful coordination between the DOJ and FTC, which based on the agencies' histories, is difficult at best and unachievable at worst.

#### Successful tech innovation combats existential climate change and runaway environmental devastation

Bai, 20

( Chunguang Bai a,\*, Patrick Dallasega b, Guido Orzes b, Joseph Sarkis c,d a School of Management and Economics, University of Electronic Science and Technology of China, No. 2006, Xiyuan Ave, West Hi-Tech Zone, 611731, Chengdu, PR China b Faculty of Science and Technology, Free University of Bozen-Bolzano, Piazza Universita 5, 39100, Bolzano, Italy c Foisie Business School, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA, 01609-2280, USA d The Humlog Institute, Hanken School of Economics, Helsinki, Finland “ Industry 4.0 technologies assessment: A sustainability perspective,” International Journal of Production Economics 229 (2020) NL) \*Tables & Graphs Omitted

The fourth industrial revolution, also labelled Industry 4.0, was beget with emergent and disruptive intelligence and information technologies. These new technologies are enabling ever-higher levels of production efficiencies. They also have the potential to dramatically influence social and environmental sustainable development. Organizations need to consider Industry 4.0 technologies contribution to sustainability. Sufficient guidance, in this respect, is lacking in the scholarly or practitioner literature. In this study, we further examine Industry 4.0 technologies in terms of application and sustainability implications. We introduce a measures framework for sustainability based on the United Nations Sustainable Development Goals; incorporating various economic, environmental and social attributes. We also develop a hybrid multi-situation decision method integrating hesitant fuzzy set, cumulative prospect theory and VIKOR. This method can effectively evaluate Industry 4.0 technologies based on their sustainable performance and application. We apply the method using secondary case information from a report of the World Economic Forum. The results show that mobile technology has the greatest impact on sustainability in all industries, and nanotechnology, mobile technology, simulation and drones have the highest impact on sustainability in the automotive, electronics, food and beverage, and textile, apparel and footwear industries, respectively. Our recommendation is to take advantage of Industry 4.0 technology adoption to improve sustainability impact but each technology needs to be carefully evaluated as specific technology will variably influence industry and sustainability dimensions. Investment in such technologies should consider appropriate priority investment and championing. 1. Introduction Industry 4.0 is transforming manufacturing firm business models. These technologies can support production flexibility, efficiency, and productivity through various emergent communication, information and intelligence technologies (Ibarra et al., 2018; Rüßmann et al., 2015). Industry 4.0 technologies include, but are not limited to, additive manufacturing, artificial intelligence, big data and analytics, blockchain, cloud, industrial internet of things, and simulation (Dalenogare et al., 2018; Bai et al., 2017). These Industry 4.0 technologies can potentially provide tremendous innovation and competitiveness growth; they may also improve current industrial system sustainability (Müller et al., 2018; Stock and Seliger, 2016). Industry 4.0 technologies adoption in companies and industries has taken on greater importance and visibility (Luthra and Mangla, 2018; de Sousa Jabbour et al., 2018; Kiel et al., 2017). Yet these technologies implications on society’s sustainability objectives require more attention and evaluation (Bai and Sarkis, 2020). Traditional production systems are notorious in their poor ecological imbalances. The litany of higher resources consumption, global warming, general environmental degradation, and higher environmental pollution are traceable to traditional manufacturing systems and technologies (Tseng et al., 2018). We also face various social problems and challenges, including poverty, inequality, prosperity, and peace and justice concerns (Griggs et al., 2013). Legitimacy theory argues that meeting key stakeholder sustainability requirements – such as carbon emissions reductions – contributes to superior performance (Lanis and Richardson, 2012). The fourth Industrial revolution can potentially address many of the ecological and social limitations of traditional industrial practices and technologies; to provide a more sustainable future (Morrar et al., 2017). Ultimately, these actions may translate into long-term organizational competitiveness. According to McKinsey’s survey of 130 firm representatives from various industries in China, Chinese manufacturing firms have great enthusiasm and expectation for Industry 4.0, but only 57% of Chinese enterprises are fully prepared for Industry 4.0 technologies. This global study showed that it is far lower than the United States (71%) and Germany (68%) (mckinsey.com, 2016). A major reason is many manufacturing firms may not understand the value of these technologies. Industry 4.0 technologies are complex and integrated architecture manufacturing-information technology integration (Frank et al., 2019). Evaluating the impact of these technologies based on standard evaluation may be difficult; but additional evaluation for sustainability benefits can increase their strategic adoption, but makes the process even more complex. Thus, it is still an important and open subject of research in Industry 4.0 evaluation (Dalenogare et al., 2018). Overall, effective and robust evaluation methods and decision support tools can help manufacturing firms effectively implement and understand those Industry 4.0 technologies; especially considering broader economic implications. These broader implications, in addition to environmental and social concerns, include building competitiveness of firms and their nations. This study argues that the principles and aims of Industry 4.0 technologies are not limited to conventional organizational business and economic performance, but will contribute to a more sustainable society. Further understanding of Industry 4.0 technologies and philosophical relationships to sustainability of society is important for practitioners; especially when capital investment decisions are to be made (Bai and Sarkis, 2013, 2017). Policymakers, seeking to make policies on Industry 4.0, could also benefit from further elicitation of this relationship (Lin et al., 2017). Yet, building and understanding the relationships between Industry 4.0 technologies and sustainability is not trivial. There is also significant lack of knowledge and uncertainty in this relationship between sustainability and Industry 4.0 technologies (Kamble et al., 2018a). This research seeks to answer three questions that address this knowledge gap and uncertainty: Q1: What value can these Industry 4.0 technologies create for economic, environmental and social sustainability, and how can they help to achieve SDGs? Q2: What are the differences in the value created by these Industry 4.0 technologies in different industries? Q3: How can the value of these Industry 4.0 technologies be effectively evaluated? This study identifies key challenges of Industry 4.0 technologies to contribute to sustainable society enhancement. This research makes three major contributions. First, we further refine Industry 4.0 technologies understanding in terms of society’s sustainability. The application scope of these technologies is evaluated using a measurement framework based on a triple-bottom-line conceptualization (Elkington, 1998). Second, a novel multi-contextual decision-making method is introduced. This methodology integrates hesitant fuzzy set (HFS), cumulative prospect theory (CPT) and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) to evaluate Industry 4.0 technologies based on their application scope. Third, the method and sustainability attributes are applied to an empirical case, using secondary published data. The methodology provides insight to managers and researchers to comprehensively evaluate Industry 4.0 technologies for adoption. The secondary data derives from the World Economic Forum White Paper “Driving the Sustainability of Production Systems with Fourth Industrial Revolution Innovation” (World Economic Forum, 2018). The overall results show that the framework, methodology, and case application can prove valuable to both practitioners and researchers. It also sets the foundation for further application and research on the relationship between Industry 4.0 and sustainability. Industry 4.0 technologies practically exhibit significant uncertainty and varying performance results across different applications or contexts. HFS can retain possible performance across multiple applications or varying opinions of all decision makers. However, the fuzzy set – alone as a basic technique – can only summarize these opinions and possible performance into a fuzzy value, and not effectively integrating diversity of the different applications and voices. This conversion of multiple opinions into a fuzzy value will result in information loss and may not accurately reflect performance within each context. Hence, HFS is an effective approach to represent and address uncertainty originating from diverse contexts and multiple decision maker involvement (Torra and Narukawa, 2009). It extends fuzzy sets and can represent the spectrum of Industry 4.0 technology possibilities across these diverse contexts. In our empirical evaluation we have completed a performance evaluation of each technology across different applications. The remainder of this paper has the following organization. Section 2 provides literature background on Industry 4.0 technologies and sustainability to help set the foundation for this research and exemplify its contribution. In section 3, the HFS, CPT and VIKOR concepts are introduced. A multi-contextual decision-making model is advanced in section 4. A comparative analysis in section 5 verifies the feasibility and capabilities of the proposed method and allows us to discuss the initial findings in light of previous Industry 4.0 research. Finally, section 6 includes conclusions, contributions, limitations and future research directions. 2. Background and literature 2.1. Industry 4.0 technologies Industry 4.0 is purported to be a new paradigm of smart and autonomous manufacturing. It more profoundly integrates manufacturing operations systems with communication, information and intelligence technologies (Wang et al., 2017; Jeschke et al., 2017). Among the litany of benefits, Industry 4.0 can provide manufacturing firms with profitable business models, higher efficiency, quality, and improved workplace conditions (Hofmann and Rüsch, 2017). It has gained considerable attention among researchers and practitioners given these potential benefits (Liao et al., 2017). But disadvantages including lack of understanding, costs, legacy system alterations, and potential energy disadvantages have made the decision for adoption and evaluation difficult (e.g. Saberi et al., 2019, which discusses barriers to blockchain technology as an example). Industry 4.0 technologies may be grouped into physical and digital technologies. Physical technologies mainly refer to manufacturing technologies such as additive manufacturing (Gibson et al., 2014), or sensors and drones (Morrar et al., 2017). Digital technologies mainly refer to modern information and communication technologies, such as cloud computing, blockchain, big data analytics, and simulation (Liao et al., 2017). Table 1 summarizes various Industry 4.0 technologies (Dalenogare et al., 2018; Lu, 2017; Wan et al., 2015; Posada et al., 2015). These Industry 4.0 technologies are relatively novel in developing countries, and in small and medium firms. Broader acceptance requires further in-depth understanding and developments especially for underrepresented populations; including Industry 4.0 impact on sustainability (Müller et al., 2018). 2.2. Industry 4.0 technologies and sustainability Industry 4.0 and sustainability1 are relatively recent emerging technological and organizational trends that are influenced by or influence improving productivity and sustainable production (Luthra and Mangla, 2018). Industry 4.0 technologies seek to overcome contemporary challenges – global competition, volatile markets and demand, increased customization through communication, information and intelligence, and decreasing innovation and product life cycles (Kiel et al., 2017). Industry 4.0 technologies potentials include substantial contributions or limitations to organizational and social sustainable development (Stock and Seliger, 2016). Considering the economic dimension, reduced set-up times, shorter lead times, reduced labor and material costs, increased production flexibility, higher productivity and enhanced customization exist (Dalenogare et al., 2018; Witkowski, 2017; Rüßmann et al., 2015). From the ecological point of view, Industry 4.0 technologies can reduce energy and resource consumption through detection and data analysis across production and supply chain processes (Shrouf et al., 2014). They can lead to reduction in waste or CO2-emissions through data-centered and traceable carbon footprint analyses (Gabriel and Pessl, 2016; Sarkis and Zhu, 2018). Products can be disassembled into their component elements for reuse, recycling, or remanufacturing. For social sustainability dimensions, smart and autonomous production systems can support employee health and safety, by taking over monotonous and repetitive tasks; resulting in higher employee satisfaction and motivation (Müller et al., 2018). However, Industry 4.0 technologies also bring many challenges and limitations to society. For example, reduced employment, information security issues, data complexity, electronic wastes, and poor quality can prevail (Rojko, 2017). Few studies provide insight into the interface between Industry 4.0 technologies and sustainability. Some of them have focused conceptually on specific sustainability related industrial concerns such as the circular economy (de Sousa Jabbour et al., 2018; Tseng et al., 2018). For a systematic review of these studies, see Beltrami and Orzes, 2019. Proponents of legitimacy theory have suggested that firms are incorporating sustainability to meet the concerns and demands of stakeholders (Park et al., 2010). As a result, manufacturing firms need to go beyond pure profit maximization, and address broader societal expectations; increasing social and environmental responsibility. Transforming industrial production through industry 4.0 to meet these sustainability needs has become a legitimacy goal (Kamble et al., 2018b). Although imperfect (Spaiser et al., 2017), the United Nations Sustainable Development Goals (SDGs) provide a common framework and set of goals for firms, industries and countries to achieve sustainable development (Robert et al., 2005). Industry 4.0 technologies have potential to benefit all 17 SDGs. Potential relationships between SDGs and Industry 4.0 technologies appear in Table 2. SDGs may be generally assigned, given there may be some overlap, to TBL dimensions. Ending poverty, providing decent work and economic growth, industry, innovation and infrastructure and reduced inequalities, partnerships for the goals are well aligned with economic sustainability attributes. Ending hunger, good health and well-being, quality education, gender equality, peace, justice and strong institutions are well aligned with social sustainability attributes. Clean water and sanitation, affordable and clean energy, sustainable cities and communities, responsible consumption and production, climate action, life below water and life on land are well aligned with environmental impact attributes. TBL, for organizational decisions, can be utilized to unfold benefits (Bai and Sarkis, 2019). This framework grounds our study for understanding Industry 4.0 technologies relationships to society’s sustainability. For example, lower emission level – climate action goal – technologies support manufacturing firm urban development efforts; and zero sewage discharge – life below water goal – technologies can aid manufacturing firms from polluting freshwater lakes. 2.3. Corporate industry 4.0 technologies evaluation and appraisal Evaluation methods can aid organizations to further understand and adopt Industry 4.0 technologies. They can support managerial decision making. Initial efforts have utilized various tools in disparate Industry 4.0 evaluation and appraisal approaches. The analytical hierarchy process (AHP) has been used to evaluate challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies (Luthra and Mangla, 2018). AHP-VIKOR methodologies were utilized to support Industry 4.0 application strategies evaluation (Erdogan et al., 2018). But, overall, the literature, thus far, has been quiet on the evaluation of Industry 4.0 technologies on sustainable performance and integrating them with by multiple attribute decision making (MADM) methods. Many MADM methods for technology evaluation exist (for example see Bai et al., 2017); but they are difficult to apply for the evaluation of Industry 4.0 technologies. First, Industry 4.0 technologies are relatively new and there is a lack of knowledge about the real impact and contribution of the Industry 4.0 technologies in general. Second, Industry 4.0 technologies need to be integrated with traditional production systems, making the fitness and compatibility issues even more important. Third, the Industry 4.0 technologies performance is associated with high uncertainties because they are applied in different contexts and industries. There is still considerable uncertainty and confusion since applications may result in contradictory performance on Industry 4.0 applications; especially in trying to balance sustainability contributions. For example, greater digitization may improve equality and economic business factors, but require additional energy requirements resulting in resource depletion or environmentally damaging emissions. These challenges in the evaluation of Industry 4.0 technologies contribute to lack of clarity in sustainability contribution from Industry 4.0 implementation. Specifically, the current academic journal published research does not provide a comprehensive decision support tool with regard to the assessment and analysis of the complex Industry 4.0 and sustainability relationships. This paper introduces a hybrid multi-context decision method that incorporates hesitant fuzzy sets, cumulative prospect theory, and VIKOR to evaluate the Industry 4.0 technologies resulting in a ranking of sustainability attributes. HFSs have been used to handle imprecise data and vague linguistic expressions of decision makers (Xu and Xia, 2011). We use HFSs to represent the uncertainty and diverse performance of Industry 4.0 technologies across different applications. CPT considers decision maker psychological characteristics under risk and uncertain environments; it also evaluates the probability of meeting sustainability performance. Most CPT related methods assume that the reference points are exogenously fixed, but it might not be true in Industry 4.0 decisions; there are shared reference points. Decision makers may update their perceptions and adjust their reference points in response to changes in different decision-making situations (Munro and Sugden, 2003). We integrate this characteristic with CPT; a new perspective not previously applied in CPT related studies. This study considers every technology as an endogenous reference point to characterize decision maker behaviors under risk or uncertainty. We also convert it into possible reference points – each Industry 4.0 technology – based on the prevalence of each technology in a decision context. In decision-making, there is a tendency to apply too much weight to low probability outcomes and too little weight to high probability outcomes (Bai and Sarkis, 2017). CPT can help alleviate this issue. Third, the VIKOR method evaluates the degree Industry 4.0 technologies relate to sustainability attributes. The valuation is based on a value between 0 and 1 [0, 1] that better represents the degree of the technology and sustainability linkage (Bai and Sarkis, 2019). Given the various limitations in methodologies and unique Industry 4.0 and sustainability relationship, we integrate HFS, CPT, and VIKOR in a multistage methodology. We now introduce some general foundation for each technique. 3. HFS, CPT and VIKOR definitions and functions In this section, we present general definitions, notation, and functions of HFS, CPT, and VIKOR. Throughout this paper, X ¼ fx1; x2;…; xng is used to denote the reference set. 3.1. Hesitant fuzzy set (HFS) HFS (Torra and Narukawa, 2009) – an extension of fuzzy sets – is used to represent and address uncertainty originating from decision maker hesitancy (doubt) in providing their alternative preferences in decision making. In our study, it represents uncertainty and performance of Industry 4.0 technologies in diverse contexts; further delineation of these contexts appears in the case application. Definition 1. A hesitant fuzzy set A on X is defined in terms of a function hAðxÞ, when applied to X returns a finite subset of values in [0, 1], AΌf<x; hAπxή>jx 2 Xg: (1) where hAðxÞ ¼ fγjγ 2 hAðxÞg, is called a hesitant fuzzy element (HFE), and represents the possible membership degrees of the element x 2 X to A. Definition 2. Let hAðxÞ and hBðxÞbe two HFEs, the number of values in HFEs hAðxÞ and hBðxÞ are defined as lðhAðxÞÞ and lðhBðxÞÞ. The number of values in different HFEs may be different. In order to be computable, we make the following assumptions (Wei, 2012). First, all the elements are arranged in decreasing order in each HFE hAðxÞ. Hence, hðoÞ A is referred to as the oth smallest value in HFE hAðxÞ. Second, for two HFEs hAðxÞ and hBðxÞ, lðhAðxÞÞ 6¼ lðhBðxÞÞ, then let l ¼ max {lðhAðxÞÞ;lðhBðxÞÞ}. Two HFEs hAðxÞ and hBðxÞcalculated from each other must be of the same length l. Hence, the smaller set is extended until it has the same number of elements as the longer set. For optimistic situations, if lðhAðxÞÞ < lðhBðxÞÞ, then hAðxÞ should repeat the maximum valued set element until it has the same length as hBðxÞ. Alternatively, for a pessimistic situation, hAðxÞ should repeat its minimum valued element until it has the same set length as hBðxÞ. Definition 3. The score function of a HFE hAðxÞis defined in (2) (Xu and Xia, 2011): sπhAπxήήΌ 1 lπhAπxήή X γ2hAπxήγ (2) Definition 4. The distance function between hAðxÞ and hBðxÞ is defined by (3): dπhAπxή; hBπxήήΌ1l Xl oΌ1 􀀀�� hπoή A πxή 􀀀 hπoή B πxή�� ! (3) 3.2. Cumulative prospect theory CPT, utilizing behavioral decision theory (Tversky and Kahneman, 1992), is a descriptive paradigm for human decision behavior under uncertainty or risk. It has been widely used to solve various decision-making problems using bounded rationality theory and subjective decision maker preferences (Bai and Sarkis, 2017). In cumulative prospect theory, the prospect value of the object is determined using a value function ϕπxiÞ. This function represents the subjective value of outcome xi and the weighting function πi of a cumulative probability p, calculated by expression (4). ϕ x; p! ¼ Xk iΌ1 ϕ xi!ππpiήώ ώ Xn iΌkώ1 ϕ xi!ππpiή􀀀 (4) The value function ϕπxiÞrepresents the risk preference and is determined by expression (5). ϕπxiήΌf πxi 􀀀 x0Þα; xi � x0 􀀀 λπ 􀀀 πxi 􀀀 x0ÞÞβ; x0 < xi (5) where xi is the subjective value of an outcome and x0 is a reference point of an outcome; ðxi 􀀀 x0Þα represents gains and􀀀 λπ 􀀀 πxi 􀀀 x0ÞÞβ represents the losses. 0 < α < 1 and 0 < β < 1 are parameters related to the exponential parameters for gains and losses, respectively. If the parameter λ > 1, then it is a loss aversion parameter; decision makers are more sensitive to losses than gains. In this study, we adopt the values of α Ό β Ό 0.88, λ Ό 2.25, which are determined by Tversky and Kahneman (1992) as reasonable initial values. The weighting function ππpiÞþ is the potential cumulative gain by expression (6), and the weighting function ππpiÞ􀀀 is the potential cumulative loss by expression (7). The cumulative probability weight function decision weights are determined by expressions (6) and (7). These functions increase the influence of rare events and shrink the influence of “average” events. πþiðpiÞ¼wþðpi þ⋯þpnÞ 􀀀 wþðpiþ1 þ⋯þpnÞ (6) π􀀀i ðpiÞ¼w􀀀 ðp1 þ⋯þpiÞ 􀀀 w􀀀 ðp1 þ⋯þpi􀀀 1Þ (7) where wþðpiÞ and w􀀀 ðpiÞ denote the weighting functions (subjective probability) for gains and losses, respectively, and defined by (8) and (9). wþðpiÞ ¼ expð 􀀀 γð 􀀀 lnðpiÞϕÞÞ (8) w􀀀 ðpiÞ ¼ expð 􀀀 ðδð 􀀀 lnðpiÞϕÞÞ (9) where pi is the objective probability, γ and δ are model parameters. wþðpiÞ and w􀀀 ðpiÞ are monotonic and exhibit inverse S-shapes for 0<γ, δ < 1. Similarly, γ ¼ δ ¼ 0.8, and ϕ ¼ 1 are determined through experiments as most realistic (Prelec, 2000). 3.3. The VIKOR method The VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR), is a MADM method for ranking and selecting alternatives (Opricovic and Tzeng, 2004). It has some advantages over other MADM methods; it can integrate conflicting criteria, provides a simple calculation process, easily scalable, and generates compromise solutions based on proximity to an ideal solution (Awasthi and Kannan, 2016). The multi-criteria measure for compromise ranking is developed with the following Lp-metric: Lp;i ¼(Xm j¼1 hwj��� �f þ j 􀀀 fij��� �.����f þ j 􀀀 f 􀀀 j ��� �ip)1=p; 1�p�∞; i¼1;…; n (10) where fþj is the best performance value for the jth attribute among all objects. Likewise, f􀀀 j is the worst performance value for the jth attribute. fij is the performance value for an objectxi with respect to the jth attribute. Within the VIKOR method p ¼ 1 (as Si) and p ¼ ∞ (as Qi) are used to formulate the ranking measure. Si ¼Lp¼1;i ¼ Xm j¼1 hwj��� �f þ j 􀀀 fij��� �.��� �f þ j 􀀀 f 􀀀 j ��� �i (11) Qi ¼Lp¼∞;i ¼maxjhwj��� �f þ j 􀀀 fij��� �.����f þ j 􀀀 f 􀀀 j ��� �i (12) VIKOR ranks the alternatives by sorting the values of Ri (see expression (13)), for i ¼ 1, 2, …, n, in increasing order. Ri ¼vðS􀀀 􀀀 SiÞ=ðS􀀀 􀀀 SþÞ þ ð1 􀀀 vÞðQ􀀀 􀀀 QiÞ=ðQ􀀀 􀀀 QþÞ (13) where Sþ ¼ min i Si, S􀀀 ¼ max i Si, Qþ ¼ min i Qi, Q􀀀 ¼ max i Qi and v is the weight on the strategy with maximum group utility and 1-v is the weight of the individual regret. 4. Case study application In this section, we develop a multi-contextual – including industry, SDG category, sustainability dimension, and technology type – method that integrates hesitant fuzzy set, cumulative prospect theory, and VIKOR for evaluating the degree of Industry 4.0 technologies. We utilize secondary data from a World Economic Forum White Paper (World Economic Forum (WEF)Accenture, 2018) to provide foundational insight on how Industry 4.0 technologies relate to sustainability. 4.1. Case background As Industry 4.0 diffuses, many regions in the world have sought to develop Industry 4.0 technologies. A World Economic Forum (WEF) project and white paper (World Economic Forum - Accenture, 2018) asked the question: “What changes will the Fourth Industrial Revolution bring to systems of production, and how will they affect sustainability?” The WEF project utilized community outreach meetings in Berlin, Germany, Dalian, China and New York to help address its question. Automotive, electronics, food and beverage, and textiles, apparel and footwear were identified as key influenced industries. Together the industries represented low and high-tech product manufacturing industries with high environmental implication relationships, end-consumer visibility and good potential for further transformation. Europe (Poland), Africa (Kenya, Ethiopia), Asia Pacific (India, Thailand, Vietnam) and Latin America (Argentina, Mexico) were examined to keep the analysis specific yet globally representative and contextual. Forty disruptive applications were identified across four industries to accelerate sustainable production practice. This evaluation framework utilized United Nation SDGs and indicators. Fourteen of the 17 SDGs were selected; these SDGs were grouped into the three areas for evaluating sustainability (economic, social and environmental). The 40 disruptive applications are based on desk research and interviews, noting upside potential and downside risks. This WEF White Paper is the fruit of an intense collaboration between 70 stakeholders from four sectors covering low-and high-tech product manufacturing industries with high environmental productivity, end-consumer visibility and good potential for further transformation (for the full list of expert, please see World Economic Forum - Accenture, 2018, pp. 47–49). We aggregated and utilized the acquired data from this study (Figures 3, 5, 7 and 9 in the White Paper) as foundational data for this study. It should be noted that the WEF report evaluates the 40 disruptive applications. This paper only focused on Industry 4.0 technologies. Their 40 applications include various Industry 4.0 technologies, biotechnology and traditional manufacturing system elements. Their corresponding relationships appear in the report. For example, Semiconductor fab 4.0 is a disruptive application in the electronics industry. It refers to the application of advanced manufacturing techniques to the production of electronic components such as silicon wafer fabrication, semiconductors and microchips – and energy and resource intensive set of processes. It contains key Industry 4.0 technologies – Cloud computing, Big data and analytics, Cobotic systems and Artificial intelligence, according to the McKinsey White Paper. The value of sustainability for Semiconductor fab 4.0 is very plausible for those four Industry 4.0 technologies. HFS is used to represent and address this uncertainty of Industry 4.0 technologies business and sustainability performance originating from the diverse and complementary disruptive applications. 4.2. Proposed methodology The proposed multi-stage methodology utilizing HFS, CPT, and VIKOR, is composed of 10 steps. These steps are detailed with exemplary calculations explicitly identified. Step 1: Construct an Industry 4.0 technologies evaluation system. An evaluation system T ¼ (U, P, C, H) for Industry 4.0 technologies based on various sustainability attributes is identified in this step. U ¼ {x1, x2, …, xn} is a set of n evaluated Industry 4.0 technologies – we will use I4.0T from now. Pt ¼ {pt1, pt2, …, ptn} is a set of probabilities of using n I4.0T in industry t, where Pn i¼1pti¼ 1. C ¼ {c1, c2, …, cm} is a set of m sustainability attributes which are used to evaluate the I4.0T. H ¼ {ht i;k, i ¼ 1, …, n, k ¼ 1, …, m and t ¼ 1, …, T } is the HFE value of I4.0T i for sustainability attribute ck in industry t. For this empirical case, a total of n ¼ 17 potential I4.0T will be in the evaluation: additive manufacturing, artificial intelligence, augmented reality, autonomous robots, big data and analytics, blockchain, cloud, cobotic systems, cybersecurity, drones, GPS, Industrial Internet of Things, mobile technology, nanotechnology, RFID, sensors and actuators and simulation (see Table 2). Each I4.0T is evaluated on m ¼ 14 sustainability attributes (SDGs). These attributes and values are from the WEF White Paper. There are four economic impact attributes: End Poverty (EP), Decent Work and Economic Growth (DWEG), Industry, Innovation and Infrastructure (III), Reduced Inequalities (RI). There are four social impact attributes: End Hunger (EH), Gender Equality (GE), Good Health and Well-being (GHW), Quality Education (QE). There are six environmental impact attributes: Clean Water and Sanitation (CWS), Affordable and Clean Energy (ACE), Sustainable Cities and Communities (SCC), Responsible Consumption and Production (RCP), Life Below Water (LBW), Life on Land (LL). Step 2: Convert application performance values into I4.0T hesitant fuzzy elements. I4.0T are not necessarily applied individually and separately. Often multiple I4.0T are applied to various disruptive industry applications each having a different performance outcome. For example, short-loop recycling in the automotive industry may utilize sensors, clouds, and big data analytics. In this multi-context decision-making environment, it is difficult for experts to evaluate each technology’s sustainability performance. There are many disruptive applications in different industries. For example, artificial intelligence (an I4.0T) can be used in various disruptive applications in the automotive industry, such as Short Loop Recycling for Manufacturing, Cobotics 2.0, Smart Digital Twins, Robotic disassembly for remanufacturing, and Smart Warehouse Robotics. The performance of those five disruptive applications can be used as a reference for the performance of artificial intelligence. A specific I4.0T may appear multiple times in different applications of one industry. In this uncertain and diverse environment, all performance values of an I4.0T for different applications can be converted into a HFE of an industry I4.0T. In this case, a value repeated more times has no more importance than other values repeated fewer times (Xu and Xia, 2011). Hence, deleting repeated values and arranging those values in decreasing order, the results evaluated in the different applications of one industry are contained in a hesitant fuzzy decision matrix, as shown in Table 3, where ht i;k are in the form of HFEs for I4.0T xi, attribute ck, and industry t. In the empirical case, artificial intelligence x2 has been applied to five different disruptive applications (Short Loop Recycling for Manufacturing, Cobotics 2.0, Smart Digital Twins, Robotic disassembly for remanufacturing, and Smart Warehouse Robotics) in the automobile industry, which yields five performance results 2, 3, 2, 2 and 2 for SDG attribute c1 (EP – ending poverty SDG). Each value uses a 0–4 scale to indicate no impact, low impact, medium impact, medium high impact, and high impact, respectively. After deleting repeated values and arranging those values in decreasing order, performance values in different applications can be converted into an HFE h1 2;1 ¼ (3, 2); appearing in the Artificial Intelligence row and EP column of Table 3. Due to space constraints, the hesitant fuzzy decision matrices of other three industries are not shown. Step 3: Calculate the HFE value function for each I4.0T SDG attribute Since SDG attribute values are HFE, the CPT value function (expression (5)) needs to be altered to calculate the HFE attribute value function. This study considers every I4.0T as a reference point for the risk aversion attitudes of decision makers. Using CPT and HFEs, the value function ϕπht i;kÞj of I4.0T xi and I4.0T xj (the reference point) for SDG attribute k in industry t is determined by expression (14): ztij;k Όϕ�hti;k�j Όnshti;k� 􀀀 s�htj;k��α; s�hti;k�>s�htj;k� 􀀀 λ 􀀀 shtj;k� 􀀀 s�hti;k���β; s�hti;k��s�htj;k� (14) For this case, the HFE of I4.0T x1 and I4.0T x2 are (3) and (3, 2) for attribute c1 (EP) in the automobile industry t ¼ 1. We find sðh1 1;1Þ ¼ 11\* 3 ¼ 3and sðh1 2;1Þ ¼ 12ð3 þ 2Þ ¼ 2:5, and the value function z112;1 ¼ ð3 􀀀 2:5ÞαΌ π0:5ÞαΌ0:88 ¼ 0.543. The value function calculation results are used to construct the value function matrix among I4.0T for attribute c1 (EP) in automobile industry t ¼ 1. The value function matrix is shown in Table 4. Due to space constraints, the value function of other attributes and other industries are not shown. Step 4: Calculate value function decision weights Using the value function ztij; k and technology probabilities Pt ¼ {pt1, pt2, …, ptn}, the value function cumulative decision weights ππpÞcan be calculated. This step is divided into three sub-steps. Sub-step 4.1 Calculate the probabilities of each I4.0T. The probability of each I4.0T needs to be calculated, and in this case represents the percentage of appearances across industry applications. The probabilitypti¼ NtiPn i¼1Nti refers to the probability of the I4.0T xi appearing in an industry. Nti refers to the number of times I4.0T xi appears in all industry t applications. Sub-step 4.2 Rank order of the value functions. An increasing rank order of the value functions ztij; k is determined by comparing ztij; k of each I4.0T xiover all other I4.0T for an attribute ck in industry t. For example, the ranking result is noted as zt ð1Þ ij;k � zt ð2Þ ij;k � … � 0 � … � zt ðnÞ ij;k , where zt ðoÞ ij;k is the oth smallest rank among ztij; k. Correspondingly, according to zt ð1Þ ij;k � zt ð2Þ ij;k � … � 0 � … � zt ðnÞ ij;k , the probability of each I4.0T is ptðoÞ, ptðoÞ 2 fpt1; pt2; :::; ptng. Sub-step 4.3 Calculate the decision weights of the value function. The decision weights πþðptðoÞÞ or π􀀀 ðptðoÞÞcan be determined for the possible values fpt1; pt2; ::: ; ptng using expressions (6) and (7). In our case, the occurrences of the 14 I4.0T in the automobile industry are 1, 5, 1, 4, 5, 1, 5, 1, 4, 1, 1, 2, 4, and 1 respectively. Thus, the probabilities of these I4.0T xi are 2.78%, 13.89%, 2.78%, 11.11%, 13.89%, 2.78%, 13.89%, 2.78%, 11.11%, 2.78%, 2.78%, 5.56%, 11.11%, and 2.78%. Second, an increasing rank order is determined by comparing the ztij; k of each I4.0T xi to other I4.0T. The ranking result is: 0 ¼ z1 ð1Þ 11;1 ¼ z1 ð2Þ 18;1 ¼ z1 ð3Þ 1 11;1 < z1 ð4Þ 12;1 ¼ z1 ð5Þ 14;1 ¼ z1 ð6Þ 15;1 ¼ z1 ð7Þ 17;1 ¼ z1 ð8Þ 19;1 ¼ z1 ð9Þ 1 13;1 < z1 ð10Þ 13;1 ¼ z1 ð11Þ 16;1 ¼ z1 ð12Þ 1 10;1 ¼ z1 ð13Þ 1 12;1 ¼ z1 ð14Þ 1 14;1 . Correspondingly, according to the ranking results, the probability of I4.0T ptðoÞ are noted as p1ð1Þ; p1ð2Þ;⋯; p1ð14Þ ¼ 2.78%, 2.78%, …, 2.78%. Using expressions (6) and (7), the cumulative decision weights for value z1 1j; 1 are 0.023, 0.149, 0.057, 0.120, 0.149, 0.057, 0.149, 0.023, 0.120, 0.057, 0.023, 0.099, 0.120, and 0.057, respectively. The cumulative decision weights are shown in Table 5. Step 5: Calculate the cumulative prospect value for each SDG attribute and each I4.0T Using the value function zt ðoÞ ij;k , decision weights πþðoÞ and π􀀀ðoÞ, the cumulative prospect value ϕt i;k of I4.0T xi for SDG attribute ck in industry t can be calculated by expression (15). ϕti;k ¼ XO o¼1 zðdÞπ􀀀ðdÞ þ Xn o¼Oþ1 zðdÞπþðdÞ (15) For example, end poverty (EP) of I4.0T x1 has 14 value functions for performance 0, 0.543, 1, 0.543, 0.543, 1, 0.543, 0, 0.543, 1, 0, 1, 0.543, 1 corresponding to all I4.0T and 14 decision weights: 0.023, 0.149, 0.057, 0.12, 0.149, 0.057, 0.149, 0.023, 0.12, 0.057, 0.023, 0.099, 0.12, 0.057. According to expression (15), the prospect value ϕ1 1;1of I4.0T x1 is:ϕ1 1;1 ¼ 0 \* 0.023 þ … … þ(1\*0.057)) ¼ 0.756. The cumulative prospect values of I4.0T on each automobile industry SDG are shown in Table 6. Step 6: Determine the ideal I4.0T solution for each industry The ‘ideal’ I4.0T X\*t for each industry will be the maximum value from each sustainability (SDG) attribute in each industry t, as in expression (16). X\*t ¼nmax i ϕti;ko (16) Using expression (16) for this case problem we have: X\*t;k¼ { 0.765, 1.291, 0.596, 0.814, 0.270, 0.415, 0.000, 0.508, 0.617, 0.860, 0.850, 0.114, 0.860, 0.228 } Step 7: Determine sustainability (SDG) attribute weights In this case, we use a simple and exact normalization formula for determining the weight of SDG attribute k using expression (17): wk ¼ Vk Pm k¼1 Vk (17) where Vk ¼ 1 T\*n2PTt¼1Pn i¼1Pnj¼1dðht i;k; htj;kÞ is the average difference between I4.0T for an SDG attribute k. n is the total number of I4.0T. dðht i;k; htj;kÞ is the Hamming distance measure between ht i;k and htj;k which is defined in expression (3). The overall attribute weight summary results appear in Table 7. Step 8: Calculate the group utility Si and the maximal regret Qi in an industry The values Si and Qi are calculated using expressions (11) and (12). For example, sustainability attribute c1 (EP) of I4.0T x1 is calculated as w1ð��� Xþ1;1 􀀀 ϕ1 1;1���Þ=ð�� �Xþ1;1 􀀀 X􀀀 1;1���Þ ¼ 0:104\* �0:765 􀀀 0:765=0:765 þ 1:470� ¼ 0. The value S1 for I4.0T x1 in automobile industry t is Pm k¼1½wkð�� �Xþ1;k 􀀀 ϕ1 1;k���Þ =ð��� Xþ1;k 􀀀 X􀀀 1;k���Þ� ¼ 0.530 for all attributes. The value Q1 for I4.0T x1 in the automobile industry is the max of above values and calculation result is w8ð�� �Xþ1;8 􀀀 ϕ1 1;8���Þ= ð�� �Xþ1;8 􀀀 X􀀀 1;8���Þ ¼ 0:087\*�0:86 þ 1:341=0:86 þ 1:341� ¼ 0.087 for attribute c8(DWEG). Step 9: Compute Ri (sustainability index) in an industry In our application, we set parameter v ¼ 0.5, which implies the maximum group utility weight equals the individual regret weight. We then get Sþ ¼ 0.214, S􀀀 ¼ 0.675, Qþ ¼ 0.087, and Q􀀀 ¼ 0.104. The value R1 of I4.0T x1 Ri ¼ vðS􀀀 􀀀 SiÞ=ðS􀀀 􀀀 SþÞþ ð1 􀀀 vÞðQ􀀀 􀀀 QiÞ=ðQ􀀀 􀀀 QþÞ ¼ 0.658. The values Si, Qi, and Ri for other I4.0T appear in Table 8 across various industries. Step 10: Calculate Cross-Industry Aggregated Index Values Ri for I4.0T The cross-industry cumulative prospect value for I4.0T based on the sustainability (SDG) measures is calculated using expression (18). Ri ¼ 1T XT t¼1 Rti(18) The calculated aggregated degrees Ri of I4.0T are shown in Table 8 (last column) and Fig. 1. The results show that overall – based on the cross-industry, cross-application case report – mobile technology has the highest degree in contributing to sustainability attributes with a score of 0.593. Augmented reality has the lowest sustainability degree with a score of 0.030. 4.3. Sensitivity analysis A joint HFS, CPT and VIKOR method is used to evaluate I4.0T. In this section, sensitivity analysis is completed to determine methodological robustness by evaluating variations of the methodology. We develop three models and compare them with the original method to show that the three approaches – HFS, CPT and VIKOR – we complementarily integrate are each necessary. The three models include: Model 1 – we apply a triangular fuzzy number ~z ¼ ðl; m; rÞ instead of HFS; Model 2 – we remove CPT from the original method; Model 3 – we do not apply the VIKOR method from the original method. We only evaluate these three model versions for the automotive industry for sensitivity illustrative purposes. The final results are summarized in Table 9. We find that rank results from the Model 1 variation causes a very significant change. As can be seen by the rankings the discriminatory power of the first model decreases versus the HFS model. That is, there are many ties in the rankings. This result shows that triangular fuzzy numbers does not reliably express clearly defined rankings for different technologies and is not as suitable for decision-making or policy setting. From amongst the three alternative sensitivity models, Model 2 has the smallest change in ranks. But there are subtle differences. This result shows that human decision behavior under uncertainty or risk should be considered in this evaluation. We found that some I4.0T valuations have changed fundamentally when applying Model 3. For example, additive manufacturing and cybersecurity changed from a two ranking to a nine ranking. This result shows that although the overall performances of these two I4.0T are low, the performance is relatively balanced without too many very poor attributes. VIKOR can evaluate these I4.0T from a holistic perspective and avoid some risks that derives from poor performance of some sustainability attributes. Overall, our conclusion is that it is necessary to address sustainability concerns from a holistic perspective with multiple complementary methodologies (Bai and Sarkis, 2019). 5. Case study results and discussion The method proposed (see Section 3) and the case study application (see Section 4) allows us to compare various I4.0T in terms of their contribution to the three dimensions of sustainability (economic, environmental and social) across different industries. The results are based on the input data – drawn from the WEF report – which reflect opinions of the experts contributing to the WEF study. We present and discuss them in order to show: (a) the capacity of the proposed methodology to comprehensively evaluate I4.0T; and (b) some preliminary results of the comparisons of I4.0T in terms of their contribution to sustainability. We complete three comparative analyses: among industries (Section 5.1), among sustainability dimensions (Section 5.2), and among sustainability dimensions and industries (Section 5.3). 5.1. Comparative analysis among industries The first comparative analysis is the impact of I4.0T to sustainability across different industries. The calculated degrees Ri of I4.0T industry sustainability impacts are shown in Table 8 and Fig. 1. This analysis shows that I4.0T have a very different sustainability impact – from 0.030 of augmented reality to 0.593 of mobile technology – with a strong industry context dependence (see Table 8). Unfortunately we cannot compare this finding with previous Industry 4.0 studies since this study paper is – to the best of our knowledge – the first one to compare various I4.0T in terms of their contribution to society’s sustainability. This result will have two significant implications for future Industry 4.0 research. First, while extant Industry 4.0 literature has usually considered I4.0T as a group of technologies without making distinctions among them (e.g., Kagermann et al., 2011; Xu et al., 2018), it seems that a more granular approach considering each I4.0T separately can provide additional insights. Second, a more contingency-based, multi-contextual approach – at least with reference to the industry – is advisable since I4.0T have very different applications and impacts in different industries (see below). As far as the automotive industry is concerned, nanotechnology is the best I4.0T for improving sustainability with a sustainability score equal to 0.887; see Table 8. This result – which is not surprising – is due to the potential contribution of nanotechnology to the development of lightweight bio-based plastics and composites. This outcome can contribute to reduce the fuel consumption, the CO2 emissions of vehicles and the use of petroleum-based plastics, relating to economic and environmental sustainability. It may also improve the livelihoods for farmers; relating to social sustainability (World Economic Forum (WEF)Accenture, 2018). Similarly, mobile technology appears as the highest scoring I4.0T in the electronics industry with an overall sustainability score equal to 1; see Table 8. This result is related to contribution of this technology to the traceability of (rare) minerals used in this industry as well as to the autonomous disassembly of electronics equipment to recycle/reuse their components. Both of these activities have significant implications for all the three sustainability dimensions (World Economic Forum (WEF) Accenture, 2018). More surprising results appear in the food and beverage, and the textiles, apparel and footwear industries. Interestingly, simulation is the I4.0T with greatest implications for improving sustainability in the food and beverage industry; a sustainability score equal to 1 in Table 8. This reason behind this high scoring for simulation is related to its potential contribution to genome editing. This application might lead to increased yield which is an economic and social sustainability contribution; for example through SDG2 zero hunger. It can also lead to decreased water usage; an environmental sustainability measure. Genome editing can contribute to increased tolerance to challenging weather conditions (World Economic Forum (WEF)Accenture, 2018). Drones are the most sustainable I4.0T in the textiles, apparel and footwear industry; with a sustainability score equal to 1, see Table 8. Drones have potential contribution to advance bio farming and precision agriculture for fiber crops (World Economic Forum (WEF)Accenture, 2018). 5.2. Comparative analysis among sustainability dimensions The second comparative analysis is the impact of I4.0T across the TBL sustainability dimensions. The aggregated degrees Ri of I4.0T are shown in Fig. 2 for economic (a), environmental (b) and social (c) dimensions. We found that blockchain technology is the most economically sustainable I4.0T (score of 0.632); confirmed by recent literature (Zhang, 2019; Grigoras et al., 2018; Cocco et al., 2017). According to Fig. 2, blockchain technology is followed by mobile technology with a score of 0.605. This is also underpinned by literature with example applications such as reduction of food waste in restaurant chains, enabling smart urban mobility and increasing productivity by means of the fifth generation of mobile technology (5G) (Hajjdiab et al., 2018; Lyons, 2018; Annunziato, 2015). Our findings show that sensors and actuators are the most environmentally sustainable I4.0T – sustainability score of 0.692. This score is closely followed by artificial intelligence (0.670), big data and analytics (0.635), and cloud (0.621). These technologies provide both hard (sensors and actuators) and soft (artificial intelligence, big data and analytics, and cloud) infrastructure for addressing energy and resource efficiency in production activities. The impact of cloud technology on environmental sustainability – from higher efficiency in materials usage, reduced use of toxic materials, and lower impact on effluents and wastes – was highlighted in Schniederjans and Hales (2016). Finally, cloud technology is the most socially sustainable I4.0T with a score of 0.646. Big data and analytics follows with a score of 0.623. This result – somewhat unexpected considering the ethics, privacy and personal autonomy issues related to the sharing of data and applications on the cloud (e.g., Isaias, 2015) – can be explained by the experts’ opinions that both cloud and big data and analytics significantly contribute to various socially influential applications. These applications include augmented workforce, robotic disassembly for remanufacturing bio-based plastics and composites, digital traceability of minerals, advanced electronic design automation, precision agriculture, and advanced bio-farming and vertical farming (World Economic Forum (WEF)Accenture, 2018). Future research is needed on these aspects, in particular with a more complete consideration of the potential negative sustainability impacts of each technology. 5.3. Comparative analysis among dimensions in each industry A complete comparative analysis of sustainability degrees Ri of each I4.0T across different sustainability dimensions in each industry is summarized in Table 10. Considering the economic sustainability perspective, Industrial Internet of Things (IoT) has a high score in the food and beverage industry (Table 10). IoT is used with other technologies such as GPS, soil sensors and weather data in the field of precision agriculture to integrate data and analytics with crop science to enable scientific farming decisions (World Economic Forum (WEF)Accenture, 2018). As such, it supports the optimization of resource usage in the fields of fertilizer, irrigation, harvesting time and seed spacing (Sambo et al., 2019). Alternatively, nanotechnology has a very low impact on increasing the economic sustainability in the textiles, apparel and footwear industry even given the medium-term perspective (5–10 years) developments; nano-tech enhanced fabrics are expected (World Economic Forum (WEF)Accenture, 2018). For the environmental sustainability dimension, autonomous robots and cobotic systems seem to have a high impact in the automotive and electronics industries (Table 10). Cobotic systems can support production in an energy and resource efficient way of electronic components. This may especially be true for silicon wafer fabrication and microchips, especially in emerging markets where there is a significant potential for efficiency gains (World Economic Forum (WEF)Accenture, 2018). Alternatively, autonomous robots seem to have little influence to increase environmental sustainability in the food and beverage industry (Table 10). This result can be explained by considering that this industry can be classified as a process industry that is generally characterized by a high-automation degree and a continuous production flow. Finally, for the social sustainability dimension, big data and analytics seem to have the highest impact in the automotive industry. Recent applications in this field are the systematic gathering and analysis of car consumer reviews to figure out the perceived advantages and disadvantages of selected vehicles (Dremel et al., 2018; Kim and Chun, 2019). Alternatively, artificial intelligence seems have little influence of I4.0T for improving social sustainability in the food and beverage industry. Even if artificial intelligence could make a significant contribution in the (analysis) and extrapolation of meaningful information from field data, the agriculture industry is faced by relatively more unpredictable events like changing weather conditions, changes in soil quality, and the unexpected influence of pests and diseases. As such, farmers may feel that their harvest will be good, but until that day arrives, the outcome will always be uncertain (Byrum, 2017). As a result, a limited impact of this technology to the social dimension can be expected because an extreme quantity of factors needs to be considered and two environments are improbably likely to be exactly the same. This environment makes the testing, validation and successful implementation of these technologies much more difficult than in other industries (Byrum, 2017). 5.4. Implications for business and government The proposed multi-contextual decision-making method for evaluating the impact of I4.0T on the three sustainability dimensions – economic, environmental and social – can be applied by both managers and policy makers for evaluating sustainability priorities and which technologies to adopt or to foster through policy interventions. The evaluation focus is enlarged from a merely economic perspective to a broader– although more complex – view in terms of environmental and social sustainability dimensions. The proposed method and results are for an empirical case, using secondary published data from a WEF report (World Economic Forum - Accenture, 2018). This information allowed us to provide insights for both managers and policy makers. Insights include evidence of the potential impact of different technologies across various sustainability dimensions and attributes in four key industries – automotive, electronics, food and beverage, textiles, apparel and footwear. As an example, according to our results (see Section 5.3) companies in the automotive industry may decide to invest in autonomous robots and cobotic systems to improve industrial and organizational environmental sustainability dimensions. Big data and analytics in this industry can effectively address social sustainability concerns. In this way we significantly support organizations and industry in their decision-making processes. Policy makers – depending on their relative concerns and community or constituent pressures they face – can incentivize and support development of particular technologies in a given industry. From a supply chain perspective companies and industrial sectors may gain competitive advantage through building sustainability performance; making companies in regions and industries more competitive for those product families and supply chains seeking to build more sustainable products and materials. Finally, the empirical case results highlights the existence of interrelationships and sometimes trade-offs between the impacts of the different I4.0T on the three sustainability dimensions These interrelationships and tradeoffs vary across different industrial sectors. The interrelationship make policy decision-making processes more complex, difficult, and with greater uncertainty. For instance, if regulators decide to support industry investment in autonomous robots and cobotic systems– increasing environmental sustainability – the resulting impact may be a negative effect on the level of employment in the automotive industry; thus, decreasing the social sustainability. The methodology provides some insights into these varying interrelationships and tradeoffs that may not only exist across technologies and sustainability dimensions, but also across industries. 6. Conclusion The applications of Industry 4.0 technologies for sustainable development seem to attract increasing attention from practitioners and scholars (Beltrami and Orzes, 2019). This attention will increase given industry’s global influence on sustainability through its supply chains, products, and processes. Some current literature examines Industry 4.0 predominantly from an organizational sustainability perspective, whereas few articles consider aspects of overall society’s sustainability; especially using the United Nations’ Sustainable Development Goals (SDGs). However, it is essential to understand the potential of I4.0T for achieving society’s sustainability through successful technology adoption and diffusion.

#### Warming causes extinction

Dr. Yew-Kwang Ng 19, Winsemius Professor of Economics at Nanyang Technological University, Fellow of the Academy of Social Sciences in Australia and Member of Advisory Board at the Global Priorities Institute at Oxford University, PhD in Economics from Sydney University, “Keynote: Global Extinction and Animal Welfare: Two Priorities for Effective Altruism”, Global Policy, Volume 10, Number 2, May 2019, pp. 258–266

Catastrophic climate change Though by no means certain, CCC causing global extinction is possible due to interrelated factors of non-linearity, cascading effects, positive feedbacks, multiplicative factors, critical thresholds and tipping points (e.g. Barnosky and Hadly, 2016; Belaia et al., 2017; Buldyrev et al., 2010; Grainger, 2017; Hansen and Sato, 2012; IPCC 2014; Kareiva and Carranza, 2018; Osmond and Klausmeier, 2017; Rothman, 2017; Schuur et al., 2015; Sims and Finnoff, 2016; Van Aalst, 2006).7 A possibly imminent tipping point could be in the form of ‘an abrupt ice sheet collapse [that] could cause a rapid sea level rise’ (Baum et al., 2011, p. 399). There are many avenues for positive feedback in global warming, including: • the replacement of an ice sea by a liquid ocean surface from melting reduces the reflection and increases the absorption of sunlight, leading to faster warming; • the drying of forests from warming increases forest fires and the release of more carbon; and • higher ocean temperatures may lead to the release of methane trapped under the ocean floor, producing runaway global warming. Though there are also avenues for negative feedback, the scientific consensus is for an overall net positive feedback (Roe and Baker, 2007). Thus, the Global Challenges Foundation (2017, p. 25) concludes, ‘The world is currently completely unprepared to envisage, and even less deal with, the consequences of CCC’. The threat of sea-level rising from global warming is well known, but there are also other likely and more imminent threats to the survivability of mankind and other living things. For example, Sherwood and Huber (2010) emphasize the adaptability limit to climate change due to heat stress from high environmental wet-bulb temperature. They show that ‘even modest global warming could ... expose large fractions of the [world] population to unprecedented heat stress’ p. 9552 and that with substantial global warming, ‘the area of land rendered uninhabitable by heat stress would dwarf that affected by rising sea level’ p. 9555, making extinction much more likely and the relatively moderate damages estimated by most integrated assessment models unreliably low. While imminent extinction is very unlikely and may not come for a long time even under business as usual, the main point is that we cannot rule it out. Annan and Hargreaves (2011, pp. 434–435) may be right that there is ‘an upper 95 per cent probability limit for S [temperature increase] ... to lie close to 4°C, and certainly well below 6°C’. However, probabilities of 5 per cent, 0.5 per cent, 0.05 per cent or even 0.005 per cent of excessive warming and the resulting extinction probabilities cannot be ruled out and are unacceptable. Even if there is only a 1 per cent probability that there is a time bomb in the airplane, you probably want to change your flight. Extinction of the whole world is more important to avoid by literally a trillion times.

#### **Independently, mismanaged tech regulation causes extinction via emerging threats**

Beckstead 14(Nick Beckstead, PhD-Rutgers, research fellow at the Future of Humanity Institute at Oxford University, oversees the Open Philanthropy Project’s grantmaking in global catastrophic risk reduction, and Toby Ord, Professor of Moral Philosophy at Oxford University and James Martin Research Fellow at the Future of Humanity Institute, Managing Existential Risk From Emerging Technologies, Ch. 10 of INNOVATION: MANAGING RISK, NOT AVOIDING IT, Annual Report of the Government Chief Scientific Adviser, 2014, <https://www.fhi.ox.ac.uk/wp-content/uploads/Managing-existential-risks-from-Emerging-Technologies.pdf>)

Historically, the risks that have arisen from emerging technologies have been small when compared with their benefits. The potential exceptions are unprecedented risks that could threaten large parts of the globe, or even our very survival . Technology has significantly improved lives in the United Kingdom and the rest of the world. Over the past 150 years, we have become much more prosperous. During this time, the UK average income rose by more than a factor of seven in real terms, much of this driven by improving technology. This increased prosperity has taken millions of people out of absolute poverty and has given everyone many more freedoms in their lives. The past 150 years also saw historically unprecedented improvements in health, with life expectancy in the United Kingdom steadily increasing by two to three years each decade. From a starting point of about 40 years, it has doubled to 80 years2 . These improvements are not entirely due to technological advances, of course, but a large fraction of them are. We have seen the cost of goods fall dramatically due to mass production, domestic time freed up via labour saving machines at home, and people connected by automobiles, railroads, airplanes, telephones, television, and the Internet. Health has improved through widespread improvements in sanitation, vaccines, antibiotics, blood transfusions, pharmaceuticals, and surgical techniques. These benefits significantly outweigh many kinds of risks that emerging technologies bring, such as those that could threaten workers in industry, local communities, consumers, or the environment. After all, the dramatic improvements in prosperity and health already include all the economic and health costs of accidents and inadvertent consequences during technological development and deployment, and the balance is still overwhelmingly positive. This is not to say that governance does or should ignore mundane risks from new technologies in the future. Good governance may have substantially decreased the risks that we faced over the previous two centuries, and if through careful policy choices we can reduce future risks without much negative impact on these emerging technologies, then we certainly should do so. However, we may not yet have seen the effects of the most important risks from technological innovation. Over the next few decades, certain technological advances may pose significant and unprecedented global risks. Advances in the biosciences and biotechnology may make it possible to create bioweapons more dangerous than any disease humanity has faced so far; geoengineering technologies could give individual countries the ability to unilaterally alter the global climate (see case study); rapid advances in artificial intelligence could give a single country a decisive strategic advantage. These scenarios are extreme, but they are recognized as potential low-probability high-impact events by relevant experts. To safely navigate these risks, and harness the potentially great benefits of these new technologies, we must continue to develop our understanding of them and ensure that the institutions responsible for monitoring them and developing policy responses are fit for purpose. This chapter explores the high-consequence risks that we can already anticipate; explains market and political challenges to adequately managing these risks; and discusses what we can do today to ensure that we achieve the potential of these technologies while keeping catastrophic threats to an acceptably low level. We need to be on our guard to ensure we are equipped to deal with these risks, have the regulatory vocabulary to manage them appropriately, and continue to develop the adaptive institutions necessary for mounting reasonable responses. Anthropogenic existential risks vs. natural existential risks An existential risk is defined as a risk that threatens the premature extinction of humanity, or the permanent and drastic destruction of its potential for desirable future development. These risks could originate in nature (as in a large asteroid impact, gamma-ray burst, supernova, supervolcano eruption, or pandemic) or through human action (as in a nuclear war, or in other cases we discuss below). This chapter focuses on anthropogenic existential risks because — as we will now argue — the probability of these risks appears significantly greater. Historical evidence shows that species like ours are not destroyed by natural catastrophes very often. Humans have existed for 200,000 years. Our closest ancestor, Homo erectus, survived for about 1.8 million years. The median mammalian species lasts for about 2.2 million years3 . Assuming that the distribution of natural existential catastrophes has not changed, we would have been unlikely to survive as long as we have if the chance of natural extinction in a given century were greater than 1 in 500 or 1 in 5,000 (since (1 – 1/500)2,000 and (1 – 1/5,000)18,000 are both less than 2%). Consistent with this general argument, all natural existential risks are believed to have very small probabilities of destroying humanity in the coming century4 . In contrast, the tentative historical evidence we do have points in the opposite direction for anthropogenic risks. The development of nuclear fission, and the atomic bomb, was the first time in history that a technology created the possibility of destroying most or all of the world’s population. Fortunately we have not yet seen a global nuclear catastrophe, but we have come extremely close. US President John F. Kennedy later confessed that during the Cuban missile crisis, the chances of a nuclear war with Russia seemed to him at the time to be “somewhere between one out of three and even”. In light of this evidence, it is intuitively rather unclear that we could survive 500 or 5,000 centuries without facing a technologically-driven global catastrophe such as a nuclear war. We argue that in the coming decades, the world can expect to see several powerful new technologies that — by accident or design — may pose equal or greater risks for humanity. 1. Engineered Pathogens Pandemics such as Spanish flu and HIV have killed tens of millions of people. Smallpox alone was responsible for more than 300 million deaths in the first half of the twentieth century. As the ongoing Ebola epidemic reminds us, disease outbreaks remain a potent threat today. However, pressures from natural selection limit the destructive potential of pathogens because a sufficiently virulent, transmissible pathogen would eliminate the host population. As others have argued, and we reiterate below, bioengineering could be used to overcome natural limits on virulence and transmissibility, allowing pandemics of unprecedented scale and severity. For an example of an increase in fatality rates, consider mousepox, a disease that is normally non-lethal in mice. In 2001, Australian researchers modified mousepox, accidentally increasing its fatality rate to 60%, even in mice with immunity to the original version5 . By 2003, researchers led by Mark Buller found a way to increase the fatality rate to 100%, although the team also found therapies that could protect mice from the engineered version6 . For an example of an increase in transmissibility, consider the ‘gain of function’ experiments on influenza that have enabled airborne transmission of modified strains of H5N1 between ferrets7 . Proponents of such experiments argue that further efforts building on their research “have contributed to our understanding of host adaptation by influenza viruses, the development of vaccines and therapeutics, and improved [disease] surveillance”8 . However, opponents argue that enhancing the transmissibility of H5N1 does little to aid in vaccine development; that long lag times between capturing and sequencing natural flu samples limits the value of this work for surveillance; and that epistasis — in which interactions between genes modulate their overall effects — limits our ability to infer the likely consequences of other genetic mutations in influenza from what we have observed in gainof-function research so far9 . Many concerns have been expressed about the catastrophic and existential risks associated with engineered pathogens. For example, George Church, a pioneer in the field of synthetic biology, has said: “While the likelihood of misuse of oligos to gain access to nearly extinct human viruses (e.g. polio) or novel pathogens (like IL4-poxvirus) is small, the consequences loom larger than chemical and nuclear weapons, since biohazards are inexpensive, can spread rapidly world-wide and evolve on their own.”10 Similarly, Richard Posner11, Nathan Myhrvold12, and Martin Rees13 have argued that in the future, an engineered pathogen with the appropriate combination of virulence, transmissibility and delay of onset in symptoms would pose an existential threat to humanity. Unfortunately, developments in this field will be much more challenging to control than nuclear weapons because the knowledge and equipment needed to engineer viruses is modest in comparison with what is required to create a nuclear weapon14. It is possible that once the field has matured over the next few decades, a single undetected terrorist group would be able to develop and deploy engineered pathogens. By the time the field is mature and its knowledge and tools are distributed across the world, it may be very challenging to defend against such a risk. This argues for the continuing development of active policy-oriented research, an intelligence service to ensure that we know what misuse some technologies are being put to, and a mature and adaptive regulatory structure in order to ensure that civilian use of materials can be appropriately developed to maximize benefit and minimize risk. We raise these potential risks to highlight some worstcase scenarios that deserve further consideration. Advances in these fields are likely to have significant positive consequences in medicine, energy, and agriculture. They may even play an important role in reducing the risk of pandemics, which currently pose a greater threat than the risks described here. 2. Artificial Intelligence Artificial intelligence (AI) is the science and engineering of intelligent machines. Narrow AI systems — such as Deep Blue, stock trading algorithms, or IBM’s Watson — work only in specific domains. In contrast, some researchers are working on AI with general capabilities, which aim to think and plan across all the domains that humans can. This general sort of AI only exists in very primitive forms today15. Many people have argued that long-term developments in artificial intelligence could have catastrophic consequences for humanity in the coming century16, while others are more skeptical17. AI researchers have differing views about when AI systems with advanced general capabilities might be developed, whether such development poses significant risks, and how seriously radical scenarios should be taken. As we’ll see, there are even differing views about how to characterize the distribution of opinion in the field. In 2012, Müller and Bostrom surveyed the 100 most-cited AI researchers to ask them when advanced AI systems might be developed, and what the likely consequences would be. The survey defined a “high-level machine intelligence” (HLMI) as a machine “that can carry out most human professions at least as well as a typical human”, and asked the researchers about which year they would assign a 10%, 50% or 90% subjective probability to such AI being developed. They also asked whether the overall consequences for humanity would be “extremely good”, “on balance good”, “more or less neutral”, “on balance bad”, or “extremely bad (existential catastrophe)”. The researchers received 29 responses: the median respondent assigned a 10% chance of HLMI by 2024, a 50% chance of HLMI by 2050, and a 90% chance of HLMI by 2070. For the impact on humanity, the median respondent assigned 20% to “extremely good”, 40% to “on balance good”, 19% to “more or less neutral”, 13% to “on balance bad”, and 8% to “extremely bad (existential catastrophe)”18. In our view, it would be a mistake to take these researchers’ probability estimates at face value, for several reasons. First, the AI researchers’ true expertise is in developing AI systems, not forecasting the consequences for society from radical developments in the field. Second, predictions about the future of AI have a mixed historical track record19. Third, these ‘subjective probabilities’ represent individuals’ personal degrees of confidence, and cannot be taken to be any kind of precise estimate of an objective chance. Fourth, only 29 out of 100 researchers responded to the survey, which therefore may not be representative of the field as a whole. The difficulty in assessing risks from AI is brought out further by a report from the Association for the Advancement of Artificial Intelligence (AAAI), which came to a different conclusion. In February 2009, about 20 leading researchers in AI met to discuss the social impacts of advances in their field. One of three sub-groups focused on potentially radical long-term implications of progress in artificial intelligence. They discussed the possibility of rapid increases in the capabilities of intelligent systems, as well as the possibility of humans losing control of machine intelligences that they had created. The overall perspective and recommendations were summarized as follows: • “The first focus group explored concerns expressed by lay people — and as popularized in science fiction for decades — about the long-term outcomes of AI research. Panelists reviewed and assessed popular expectations and concerns. The focus group noted a tendency for the general public, science-fiction writers, and futurists to dwell on radical longterm outcomes of AI research, while overlooking the broad spectrum of opportunities and challenges with developing and fielding applications that leverage different aspects of machine intelligence.” • “There was overall skepticism about the prospect of an intelligence explosion as well as of a “coming singularity,” and also about the large-scale loss of control of intelligent systems. Nevertheless, there was a shared sense that additional research would be valuable on methods for understanding and verifying the range of behaviors of complex computational systems to minimize unexpected outcomes.” • “The group suggested outreach and communication to people and organizations about the low likelihood of the radical outcomes, sharing the rationale for the overall comfort of scientists in this realm, and for the need to educate people outside the AI research community about the promise of AI for enhancing the quality of human life in numerous ways, coupled with a re-focusing of attention on actionable, shorter-term challenges.”20 This panel gathered prominent people in the field to discuss the social implications of advances in AI in response to concerns from the public and other researchers. They reported on their views about the concerns, recommended plausible avenues for deeper investigation, and highlighted the possible upsides of progress in addition to discussing the downsides. These were valuable contributions. However, the event had shortcomings as well. First, there is reason to doubt that the AAAI panel succeeded in accurately reporting the field’s level of concern about future developments in AI. Recent commentary on these issues from AI researchers has struck a different tone. For instance, the survey discussed above seems to indicate more widespread concern. Moreover, Stuart Russell — a leader in the field and author of the most-used textbook in AI — has begun publicly discussing AI as a potential existential risk21. In addition, the AAAI panel did not significantly engage with concerned researchers and members of the public, who had no representatives at the conference, and the AAAI panel did not explain their reasons for being sceptical of concerns about the long-term implications of AI, contrary to standard recommendations for ‘inclusion’ or ‘engagement’ in the field of responsible innovation22. In place of arguments, they offered language suggesting that these concerns were primarily held by “non-experts” and belonged in the realm of science fiction. It’s questionable whether there is genuine expertise in predicting the long-term future of AI at all23, and unclear how much better AI researchers would be than other informed people. But this kind of dismissal is especially questionable in light of the fact that many AI researchers in the survey mentioned above thought the risk of “extremely bad” outcomes for humanity from long-term 120 progress in AI had probabilities that were far from negligible. At present, there is no indication that the concerns of the public and researchers in other fields have been assuaged by the AAAI panel’s interim report or any subsequent outreach effort. What then, if anything, can we infer from these two different pieces of work? The survey suggests that some AI researchers believe that the development of advanced AI systems poses non-negligible risks of extremely bad outcomes for humanity, whilst the AAAI panel was skeptical of radical outcomes. Under these circumstances, it is impossible to rule out the possibility of a genuine risk, making a case for deeper investigation of the potential problem and the possible responses and including long-term risks from AI in horizon-scanning efforts by government. Challenges of managing existential risks from emerging technology Existential risks from emerging technologies pose distinctive challenges for regulation, for the following reasons: 1. The stakes involved in an existential catastrophe are extremely large, so even an extremely small risk can carry an unacceptably large expected cost24. Therefore, we should seek a high degree of certainty that all reasonable steps have been taken to minimize existential risks with a sufficient baseline of scientific plausibility. 2. All of the technologies discussed above are likely to be difficult to control (much harder than nuclear weapons). Small states or even non-state actors may eventually be able to cause major global problems. 3. The development of these technologies may be unexpectedly rapid, catching the political world off guard. This highlights the importance of carefully considering existential risks in the context of horizon-scanning efforts, foresight programs, risk and uncertainty assessments, and policy-oriented research. 4. Unlike risks with smaller stakes, we cannot rely on learning to manage existential risks through trial and error. Instead, it is important for government to investigate potential existential risks and develop appropriate responses even when the potential threat and options for mitigating it are highly uncertain or speculative. As we seek to maintain and develop the adaptive institutions necessary to manage existential risks from emerging technologies, there are some political challenges that are worth considering: 1. Reduction of the risk of an existential catastrophe is a global public good, because everyone benefits25. Markets typically undersupply global public goods, and large-scale cooperation is often required to overcome this. Even a large country acting in the interests of its citizens may have incentives to underinvest in ameliorating existential risk. For some threats the situation may be even worse, since even a single non-compliant country could pose severe problems. 2. The measures we take to prepare for existential risks from emerging technology will inevitably be speculative, making it hard to achieve consensus about how to respond. 3. Actions we might take to ameliorate these risks are likely to involve regulation. The costs of such regulation would likely be concentrated on the regulators and the industries, whereas the benefits would be widely dispersed and largely invisible — a classic recipe for regulatory failure. 4. Many of the benefits of minimizing existential risks accrue to future generations, and their interests are inherently difficult to incorporate into political decision-making. Conclusion In the coming decades, we may face existential risks from a number of sources including the development of engineered pathogens, advanced AI, or geoengineering. In response, we must consider these potential risks in the context of horizon-scanning efforts, foresight programs, risk and uncertainty assessments, and policy-oriented research. This may involve significant political and coordination challenges, but given the high stakes we must take reasonable steps to ensure that we fully realize the potential gains from these technologies while keeping any existential risks to an absolute minimum. [Inset] Case Study: Policy, Decisionmaking, and Existential Risk Geoengineering is the deliberate use of technology to alter planet-scale characteristics of the Earth, such as its climatic system. Geoengineering techniques have been proposed as a defence against global warming. For example, sulphate aerosols have a global cooling effect: by pumping sulphate aerosols into the high atmosphere, it may be possible to decrease global temperatures. Alternatively, seeding suitable ocean areas with comparatively small amounts of iron might increase plankton growth sufficiently to sequester significant quantities of atmospheric carbon dioxide. These technologies are already within reach, or nearly so (although their efficacy is still difficult to predict). As global warming worsens, the case for using one or more of them to ameliorate the causes or avert the effects of climate change may strengthen. Yet the long-term consequences of these techniques are poorly understood, and there may be a risk of global catastrophe if they were to be deployed, for example through unexpected effects on the global climate or the marine ecosystem. This example illustrates the policy dimensions of existential risk in several ways. 1. It involves potentially beneficial technologies that may come with a small (though difficult to assess) risk of catastrophic side effects. 2. These risks are associated with the fact that the technology is global in impact. If we choose to employ it, we are putting all our eggs in one basket. This is especially obvious in the case of geoengineering, because the technology is intended to have planetlevel effects. But it is also true of other potential sources of existential risk, such as synthetic biology or artificial intelligence, in the sense that it is unlikely that these technologies could be deployed merely locally — within a single nation, for example. 3. Some of the potential risks are associated with lock-in costs. If we choose one path now, it may be difficult or impossible to retreat later if unintended consequences become apparent — for example, there might be a risk of catastrophic sudden warming if the use of stratospheric aerosols was suddenly discontinued. 4. Once the technology is available, making a choice on its use is unavoidable — even a decision to do nothing is still a decision. Whatever we decide, our choice will have long-term consequences. However, geoengineering technology differs from some other potential sources of existential risk in that not using it is a feasible option, perhaps even the default option (at least for the time being). In other cases, various short-term benefits and associated commercial factors are likely to provide strong incentives to develop the technologies in question, and the task of managing extreme risks is to find opportunities to steer that development in order to reduce the probability of catastrophic surprises. 5. The decision to deploy geoengineering technology could, in principle, be made by a single nation or even a wealthy individual. In this respect, too, geoengineering illustrates one of the characteristic features of extreme technological risks: they are associated with the fact that powerful technologies put more power into fewer hands.

#### Antitrust uncertainty particularly deters foreign companies from investing in the US

Clougherty, 21

(Joseph A. Clougherty1 and Nan Zhang2 1 Gies College of Business, University of Illinois at Urbana-Champaign, 330 Wohlers Hall, 1206 S. 6th St., MC-706, Champaign, IL 61820, USA; 2 College of Business Administration, California State University Stanislaus, 223 Demergasso-Bava Hall #21, One University Circle, Turlock, CA 95382, USA, “Foreign investor reactions to risk and uncertainty in antitrust: U.S. merger policy investigations and the deterrence of foreign acquirer presence,” Journal of International Business Studies (2021) 52 NL)

A number of observers have recognized that antitrust enforcement can generate consequences for foreign firms considering to invest in a particular host country. Moreover, the relatively thin empirical literature on this topic presents mixed findings as to whether antitrust enforcement promotes or deters inward FDI activities. Some scholars find evidence in support of a positive relationship between antitrust and inward FDI, as foreign investors value the levelplaying-field aspects of antitrust that mitigate liability of foreignness. Yet other scholars find evidence in support of a negative relationship between antitrust and inward FDI, as the application of antitrust might tend to be protectionist in nature. This debate with regard to the relationship between antitrust and foreign investment has long roots, although the relevance of this debate has heightened over the last two decades (e.g., Carletti, Spagnolo, Caiazza, & Giannetti, 2010; Fingleton, 2009). With the aim of bringing some clarity to the above discourse, our conceptual framework generates two theoretical contentions. Our first theoretical prior contends that merger policy risk negatively affects the relative presence of foreign acquirers in local M&A markets. Merger policy risk likely involves a larger deterrence effect with respect to foreign investor activities as compared to domestic investor activities due to the presence of three mechanisms. First, foreign investors disproportionately experience the costs involved with navigating the merger review process due to their inherent liabilities and information asymmetries. Second, foreign investors tend to be more risk averse as compared to domestic investors, thus generating more cautious investment behavior. Third, antitrust agencies potentially exhibit bias and protectionism by disproportionately targeting and scrutinizing foreign investor acquisition activities. These three mechanisms first lead to reduced foreign investor participation in local M&A markets, and ultimately lead to the deterrence of future cross-border acquisitions as foreign investors refrain from such activities due to the presence of policy risks. In a similar vein, our second theoretical prior contends that merger policy uncertainty negatively affects the relative presence of foreign acquirers in local M&A markets. Merger policy uncertainty likely involves a larger deterrence effect with respect to foreign investor activities as compared to domestic investor activities due to the presence of substantial information asymmetries on the part of foreign investors. Investors hailing from foreign countries face particular disadvantages with respect to properly assessing the policy uncertainties associated with alterations in the future states of merger review. Thus, higher degrees of policy uncertainty regarding the future strength and tenor of the merger review process lead to reduced foreign investor participation in local M&A markets. In addition to negatively impacting foreign acquisitions of indigenous firms, this leads to the deterrence of future cross-border acquisitions as foreign investors refrain from such activities due to the presence of policy uncertainties.

#### Foreign direct investment prevents conflict escalation

Bryan Borzykowski, 7-6-18. CNBC business writer and editor quoting Mark Zandi, chief economist at Moody’s Analytics,” “The dire ripple effect from a US-China trade war: A drop in foreign investment worldwide,” CNBC. https://www.cnbc.com/2018/07/05/ripple-effect-from-pending-us-china-trade-war-drop-in-fdi-worldwide.html

The impact of lower FDI While FDI may not get the kind of attention that trade does, falling figures should be a concern for international investors and anyone who believes in globalization, said Bernard Wolf, an economics and international business professor at Toronto’s Schulich School of Business. “Both trade and FDI generally make the world a more efficient place,” he said. It can increase competition in markets, it brings people with new skills and knowhow to new countries and in the case of a merger of a public company, where one company buys another for a premium price, it can give investors a portfolio boost. “Globalization, including FDI, has enormous benefits,” he said. FDI also helps cooler heads prevail during conflicts, added Zandi. If countries are doing business with each other, they’ll be less likely to go to war with one another. “If your economic interests are aligned, and if we own a piece of their economy and they own a piece of ours, then everyone has skin in the game,” he said. “That’s a benefit we’re going to give up if we continue on this path.” In Zandi’s view, the timing for an FDI decline couldn’t be worse. As populations in emerging market countries move into the middle class, demand for developed market-made goods and services has never been higher. While he does say that globalization hasn’t benefited everyone, especially on the manufacturing side, more money will start flowing from China and other developing nations into America instead of vice-versa. “Pulling back now is a dark irony,” he said. “Countries like the U.S., Canada and the U.K. are producing things no one else on the planet is producing and we were really going to reap the benefits of that.” While American FDI into other countries is still robust ­— the U.S. invests about four times more into China than vice-versa — a global trade war could cause other countries to put restrictions on U.S. operations and that could impact domestic jobs and the American economy, said Hanemann. “That’s a major concern and something politicians in the U.S. aren’t talking about,” he said. “If we see a change in U.S. openness to Chinese investment, we will most certainly see a retaliation from China against U.S. investors. The U.S. has a lot more to lose from a more restrictive investment environment than China has.”

#### Dual enforcement has also caused the Axon case to rise to the Supreme Court, who will decide in favor of the plaintiff now. Doing so will strip the FTC of all regulatory power due to its unconstitutional antitrust action—only the aff solves by mooting the suit

Tyler 21, Eleanor Tyler, 7-29-2021, Eleanor Tyler is a Legal Analyst on the Litigation team, with a focus on antitrust. Previously, she spent seven years reporting for Bloomberg Law's antitrust news desk. Before joining Bloomberg Law in 2010, Eleanor was a litigation associate at a large law firm. She clerked for the Hon. Simeon Lake in the U.S. District Court for the Southern District of Texas. Her JD is from Georgetown University, and she holds an MA in international affairs from Johns Hopkins SAIS, "ANALYSIS: Axon’s SCOTUS Attack May Pose a Threat to the FTC," Bloomberg Law, https://news.bloomberglaw.com/bloomberg-law-analysis/analysis-axons-scotus-attack-may-pose-a-threat-to-the-ftc

A seemingly technical challenge to the Federal Trade Commission based on exhaustion of administrative remedies could upend the structure of the FTC’s enforcement efforts.

Former Solicitor General Paul D. Clement filed a petition for writ of certiorari before the U.S. Supreme Court July 20 on behalf of Axon Enterprise Inc., seeking to reverse lower court holdings that Axon must complete the FTC’s administrative enforcement process before challenging the constitutionality of that process in court.

Clement’s petition also asks the court to reach the merits of Axon’s challenge to the FTC’s administrative enforcement structure, which an Arizona federal court and the U.S. Court of Appeals for the Ninth Circuit held they lacked jurisdiction to consider.

Essentially, this is an attack on the entire structure of the FTC and its role in antitrust enforcement. For several reasons, the case stands a better-than-normal chance of being accepted by the Supreme Court and potentially dealing a serious blow to the FTC. The Court seems receptive to this kind of argument, and has proven receptive to the lawyer who makes it.

FTC Challenges Merger

Axon bought rival body camera manufacturer Vievu LLC in May 2018. The FTC opened an investigation into the merger shortly thereafter, and in December 2019, demanded that Axon spin off Vievu—with Axon’s technology—as a “cloned” competitor.

Facing an administrative enforcement action to force a breakup, Axon brought suit in Arizona federal court, alleging that the FTC’s administrative process is unconstitutional and seeking a declaratory judgment that the merger was legal.

Axon argued that the combination of “investigatory, prosecutorial, adjudicative, and appellate functions within a single agency” violates due process. Axon contended that if it has to litigate for years at the FTC before reaching a court that can consider its constitutional complaints and the merits of its defense to the merger challenge, then its due process rights are violated. Axon also contended that the FTC’s administrative law judge is improperly appointed, and thus can’t legally preside over Axon’s case, and that the whole process by which mergers are reviewed by the FTC or Justice Department is unconstitutional.

Judge Dominic Lanza of the federal district court held that district courts lack subject matter jurisdiction to weigh in on an FTC administrative enforcement matter because the FTC Act strips them of that ability. Under the Act, ALJ decisions at the FTC are reviewed by the Federal Trade Commission, whose decisions are in turn reviewed by an appellate court; that doesn’t leave room for the district court to interfere, Lanza said. Furthermore, because Axon will have a constitutional complaint only if the FTC administrative process concludes against Axon’s merger, he said, Axon may never even suffer a harm that needs adjudicating in court.

Axon appealed, countering that being forced through the very administrative process it challenges harms Axon regardless of outcome. The Ninth Circuit rejected its appeal in a split decision, reasoning that Congress’s adjudicative structure for FTC enforcement should be followed under existing Supreme Court precedent.

Clement petitioned SCOTUS to review the lower courts’ holdings on jurisdiction and reach the merits. The questions presented in his petition are:

Whether Congress [in the FTC Act] impliedly stripped federal district courts of jurisdiction over constitutional challenges to the FTC’s structure, procedures, and existence by granting the courts of appeals jurisdiction to “affirm, enforce, modify, or set aside” the Commission’s cease-and-desist orders; and

Whether, on the merits, the structure of the FTC, including the dual-layer for-cause removal protections afforded its administrative law judges, is consistent with the Constitution.

Receptive Court?

Under normal circumstances, one might not worry inordinately about a petition asking the Supreme Court to declare unconstitutional an agency structure that has been functioning admirably for 100 years.

For starters, any given petition for certiorari to the Supreme Court ordinarily has a lousy chance of being granted. According to U.S. Courts statistics, during the fiscal year ending Sept. 30, 2020, the Supreme Court had 5,518 petitions originating in the eleven appellate circuits (and D.C. circuit) pending consideration, and only 120 were granted—a success rate of 2.17%.

But Clement’s success rate for getting SCOTUS petitions heard is 10 times higher than that baseline success rate: A petition for certiorari with his name at the bottom has a one-in-five chance of being heard by the Court.

Second, the Court seems receptive to the types of arguments Axon is making, having taken a number of appointments clause cases in the past decade. In 2018, for example, in Lucia v. SEC, the Court held that the ALJs that preside over SEC administrative enforcement actions, which are similar to FTC actions, are “inferior officers.”

Axon is arguing that, under the Court’s 2010 decision in Free Enter. Fund v. Pub. Accounting Oversight Bd, “inferior officers” are inappropriately protected from removal by the president if they are removable only “for cause” by principal officers who likewise can only be removed “for cause.” Because the FTC ALJ can only be removed for cause, and those empowered to remove him can only be removed themselves for “inefficiency, neglect of duty, or malfeasance,” Axon argues the FTC’s “dual for-cause” structure protecting the ALJ violates the appointments clause under a “straightforward application” of Free Enter. Fund.

The court has also proved hostile to implied readings of the FTC Act. Just this April, the Court held that the FTC Act’s grant of power to seek a “permanent injunction” in court didn’t also imply the power to seek other equitable remedies like disgorgement, reversing decades of practice. Strictly on the jurisdictional issue of whether the courts can consider Axon’s constitutional claims before the FTC’s process concludes, the court may decline to read into the FTC Act a bar on Axon’s court case.

In short, the Court seems receptive to the kinds of arguments that Axon is advancing and Axon’s lawyer is exceptionally skilled at getting the Court to consider litigants’ arguments.

#### Successful *Axon* litigation overturns the entire *administrative state*

Victoria Graham, 1-10-2020, Graham had been at Bloomberg Industry Group since August 2017, covering antitrust policy and litigation. She reported on high-profile merger lawsuits (AT&T-Time Warner, Sprint-T-Mobile) as well as antitrust oversight by the Justice Department, Federal Trade Commission, state attorneys general, and Congress, "Axon Targets FTC Antitrust Power and Could Hit Other Agencies," Bloomberg Law, https://news.bloomberglaw.com/mergers-and-acquisitions/axon-targets-ftc-antitrust-power-and-could-hit-other-agencies

A police camera equipment and taser manufacturer’s challenge to a merger rejection could pose risks for federal agencies far beyond its intended target: the Federal Trade Commission.

Axon Enterprise Inc. is seeking to save its merger with a rival by challenging the FTC’s ability to both prosecute and judge cases and asking a federal court to rule the agency’s structure unconstitutional.

The case, the first of its kind in more than a decade, comes at a time when the FTC isn’t doing very well in federal court defending the reach of its power. The FTC has lost two such cases in the last year alone.

“Ten years ago I would have been surprised by this sort of suit but the FTC keeps getting socked,” Chris Sagers, an antitrust law professor at Cleveland State University, said.

The case poses risks well beyond the FTC since other agencies such as the Food and Drug Administration use similar in-house administrative processes as governed by a federal law known as the Administrative Procedure Act.

If the FTC’s process is found to be unconstitutional, “than there is more at stake than just the FTC,” Darren Bush, an antitrust law professor at the University of Houston, said.

“This lawsuit is a direct assault on the Administrative Procedure Act which makes it a much bigger case,” Sagers added.

Whole Foods

A company last challenged the FTC’s structure in 2008 when Whole Foods Market Inc. counter-sued the commission after it ordered the supermarket chain to unwind its $565 million acquisition of Wild Oats Markets. However, Whole Foods and the FTC quickly reached a settlement and the case was dismissed.

Axon’s suit “is a serious and sobering challenge, " Sagers said.

#### **The Administrative State solves everything**

Bazelon & Posner 17 -- Emily Bazelon, staff writer. Eric Posner, Law Professor at the University of Chicago. [The Government Gorsuch Wants to Undo, 4-1-17, https://www.nytimes.com/2017/04/01/sunday-review/the-government-gorsuch-wants-to-undo.html]

The 80 years of law that are at stake began with the New Deal. President Franklin D. Roosevelt believed that the Great Depression was caused in part by ruinous competition among companies. In 1933, Congress passed the National Industrial Recovery Act, which allowed the president to approve “fair competition” standards for different trades and industries. The next year, Roosevelt approved a code for the poultry industry, which, among other things, set a minimum wage and maximum hours for workers, and hygiene requirements for slaughterhouses. Such basic workplace protections and constraints on the free market are now taken for granted. But in 1935, after a New York City slaughterhouse operator was convicted of violating the poultry code, the Supreme Court called into question the whole approach of the New Deal, by holding that the N.I.R.A. was an “unconstitutional delegation by Congress of a legislative power.” Only Congress can create rules like the poultry code, the justices said. Because Congress did not define “fair competition,” leaving the rule-making to the president, the N.I.R.A. violated the Constitution’s separation of powers. The court’s ruling in Schechter Poultry Corp. v. the United States, along with another case decided the same year, are the only instances in which the Supreme Court has ever struck down a federal statute based on this rationale, known as the “nondelegation doctrine.” Schechter Poultry’s stand against executive-branch rule-making proved to be a legal dead end, and for good reason. As the court has recognized over and over, before and since 1935, Congress is a cumbersome body that moves slowly in the best of times, while the economy is an incredibly dynamic system. For the sake of business as well as labor, the updating of regulations can’t wait for Congress to give highly specific and detailed directions. The New Deal filled the gap by giving policy-making authority to agencies, including the Securities and Exchange Commission, which protects investors, and the National Labor Relations Board, which oversees collective bargaining between unions and employers. Later came other agencies, including the Environmental Protection Agency, the Occupational Safety and Health Administration (which regulates workplace safety) and the Department of Homeland Security. Still other agencies regulate the broadcast spectrum, keep the national parks open, help farmers and assist Americans who are overseas. Administrative agencies coordinated the response to Sept. 11, kept the Ebola outbreak in check and were instrumental to ending the last financial crisis. They regulate the safety of food, drugs, airplanes and nuclear power plants. The administrative state isn’t optional in our complex society. It’s indispensable.

#### Strong administrative state checks economic inequality

Rahman 18 – Associate Professor of Law, Brooklyn Law School  
Sabeel Rahman, Visiting Professor of Law at Harvard and Fellow at the Roosevelt Institute, Reconstructing the Administrative State in an Era of Economic and Democratic Crisis, 131 Harv. L. Rev. 1671, April 2018,

The **rise of the administrative state** was thus not a politically neutral endeavor. The checks and balances that legitimate administrative authority in essence make possible (but do not guarantee) the contestation of deep forms of economic and social inequality, subordination, or hierarchy**.** This is not to say that administrative authority is always equality or inclusion promoting — hardly. But in a reality where background economic, social, and historical conditions already encode structural disparities of wealth, opportunity, power, and influence, eliminating regulatory agencies and tools that are potentially capable of addressing these disparities (even if they are not always deployed in these ways) precludes much of **equality- or inclusion-promoting public polic**y from getting off the ground in the first place. The dismantling of administrative institutions, then, is similarly nonneutral. Scholars of the administrative process have long warned of the dangers of special interest capture of regulatory agencies, which would cause administrative authority to be **redirected to serve some interests over others**. But agencies can also be captured and neutered through *inaction* — through what political scientists call “drift,” where highly resourced and sophisticated players are able to produce substantive policy change simply by holding existing rules in place in the face of changing external conditions.Dismantling agencies altogether would be an even more extreme form of opposition to these potential uses: rather than trying to capture or simply neuter the agency, more radical efforts to deconstruct regulatory institutions cut off the very possibility by **eliminating** the **regulatory capacity** itself, a kind of complete and total capture through deconstruction. This substantive valence of administrative power and its potential deconstruction adds an important layer to Michaels’s critique of privatization. Michaels alludes to the ways in which privatization risks permanently dismantling institutional tools and capacities that are difficult to rebuild. As Michaels warns, **under privatization,** “we will have hollowed out the government sector to such an extent that we may well lack **the** capacity, infrastructure, **and** know-how to **reclaim** that which has increasingly been outsourced or marketized” (p. 12). He rightly notes that privatization emerged as a “pivot[]” strategy in the Reagan era, a “second-best” to dismantling regulatory bodies themselves (p. 97). This is a problem in particular because “the Market, at least in its pure, idealized state, **is not democratic, deliberative, or juridical**. . . . It is the world of Schumpeter and Coase, not Montesquieu or Madison” (p. 5). Private corporate governance, meanwhile, cannot replicate the kinds of checks and balances that the separation of powers principles require (p. 164). **Dismantling** administration and returning to private ordering is therefore **troubling for democracy in three senses**. First, given prior background structural patterns of exclusion and disparities of wealth, power, and opportunity, a return to private economic and social ordering is by definition a return to economic inequality, social hierarchy, and exclusion. Second, the dynamics of market competition or of **corporate governance cannot replicate or replace** public **institutions** of **democracy or of checks and balances**. They operate fundamentally differently and are not substitutes. Third, a dismantling of regulatory institutions removes some of the most **vital and effective mechanisms** through which we as a **democratic public seek to contest and reshape** these background structural inequities and exclusions: **without** tools of general administrative **policymaking and enforcement**, these structural inequities are **harder to overcome and reshape**.

#### Economic inequality causes social collapse and extinction

Brown, 14

([Alex Brown](https://www.theatlantic.com/author/alex-brown/) is a Congressional correspondent at National Journal. "Here's How NASA Thinks Society Will Collapse," March 18 2014 <https://www.theatlantic.com/politics/archive/2014/03/heres-how-nasa-thinks-society-will-collapse/441375/> NL)

Few think Western civilization is on the brink of collapse — but it's also doubtful the Romans and Mesopotamians saw their own demise coming either. If we're to avoid their fate, we'll need policies to reduce economic inequality and preserve natural resources, according to a NASA-funded study that looked at the collapses of previous societies. "Two important features seem to appear across societies that have collapsed," reads the study. "The stretching of resources due to the strain placed on the ecological carrying capacity and the economic stratification of society into Elites and Masses." In unequal societies, researchers said, "collapse is difficult to avoid.... Elites grow and consume too much, resulting in a famine among Commoners that eventually causes the collapse of society." As limited resources plague the working class, the wealthy, insulated from the problem, "continue consuming unequally" and exacerbate the issue, the study said. Meanwhile, resources continue to be used up, even by the technologies designed to preserve them. For instance, "an increase in vehicle fuel efficiency technology tends to enable increased per capita vehicle miles driven, heavier cars, and higher average speeds, which then negate the gains from the increased fuel-efficiency," the study said. The researchers used what they termed a Human And Nature DYnamical (HANDY) formula to reach their conclusions. The formula uses factors such as birth rates, resources, and income classes to create a mathematical equation to project outcomes. The study was sponsored by NASA's Goddard Space Flight Center and headed by the National Science Foundation's Safa Motesharrei. For those who think modern society is immune from the problems that brought down ancient civilizations, a "brief overview of collapses demonstrates not only the ubiquity of the phenomenon, but also the extent to which advanced, complex and powerful societies are susceptible to collapse," the study said. So how do we save ourselves? "Collapse can be avoided, and population can reach a steady state at the maximum carrying capacity, if the rate of depletion of nature is reduced to a sustainable level, and if resources are distributed equitably," reads the report.

#### The United States federal government should expand the scope of the Sherman Act to give the Department of Justice exclusive authority over antitrust law.

### Adv 2 is Turf Wars

#### Dividing regulatory authority between the DOJ and the FTC is awful for both agencies—

#### First is the DOJ--

#### The division of power ruins the DOJ’s foreign policy signaling and radically weakens national security—the FTC consistently rules against the US’ best interests, which guarantees we lose the tech race to China and causes Hauwei to gain an international foothold

McGinnis and Sun 21, John O. McGinnis is the George C. Dix Professor in Constitutional Law at Northwestern Pritzker School of Law. McGinnis is a panelist called on to decide WTO disputes and graduate of Harvard Law School, Linda Sun is an intellectual property lawyer at Wilmerhale and former editor in chief of Northwestern Journal of Technology and Intellectual Property during her time at Northwestern Pritzker School of Law, “Unifying Antitrust Enforcement for the Digital Age”, 78 Wash. & Lee L. Rev. 305, 2021

ANTITRUST ENFORCEMENT SHOULD BE CONSOLIDATED WITHIN THE DEPARTMENT OF JUSTICE

With the understanding that dual enforcement cannot continue, this Part explains why antitrust enforcement is best placed under the DOJ's Antitrust Division. We first show that the DOJ, not the FTC, should be the choice because antitrust now has serious foreign policy and national security ramifications in our technological era that must be handled by an agency directly responsible to the president, who controls the numerous other mechanisms for dealing with such issues. 247 We next show that removing the FTC from antitrust will have the substantial added advantage of improving its oversight of privacy-a consumer protection matter also given new prominence by technology.

A. Antitrust Policy Increasingly Implicates Foreign Policy

Antitrust law has always affected foreign policy. That much is evident in the various international antitrust organizations and agreements in existence. 248 Enforcement decisions, even those involving only domestic companies, have political and economic ramifications for the United States internationally. 249

However, antitrust law plays a particularly important role in international politics today due to the rise of technology. Technology has revolutionized foreign intelligence and espionage. 2 50 Accordingly, countries have grappled for control of the technology industry, notably China and the United States, 251 initiating "the technology cold war." 252 Both the United States and China have used antitrust regulation to further their position in this technology war. 253 Therefore, technological advancement requires that antitrust enforcement be carefully coordinated with foreign policy.

The executive branch, specifically the president, directs and controls relations with international entities. 254 Thomas Jefferson described the president as "the only channel of communication between the United States and foreign nations." 255 Traditional descriptions of executive power by political writers have necessarily included foreign affairs powers. 256 The Constitution specifically enumerates the president's power to make treaties, appoint ambassadors, and control the army and navy. 257 These designations enable the president to conduct diplomacy with foreign nations. 258 The Supreme Court has affirmed that the president is "the sole organ of the federal government in the field of international relations." 259 The secretary of state, the Foreign Service, and the U.S. Agency for International Development report to the president and carry out his or her foreign policy.2 0 Outside of constitutional grants of power, as a practical matter, the president is generally privy to information relevant to foreign affairs on a more up-to-date basis than other governmental bodies.26 1 His or her constitutional power and comparative information advantage both place the president in a position to direct international relations and safeguard against foreign threats. Therefore, the president must directly oversee antitrust policy to carry out his or her constitutional foreign policy duties.

The president has such direct oversight of the DOJ. The president appoints the attorney general and assistant attorneys general 262 and retains the power to fire these agents at will. 26 3 The Antitrust Division has a particularly hierarchal structure wherein the president appoints an assistant attorney general who oversees the entire Antitrust Division. 2 64 The same cannot be said for the FTC. The FTC is an independent agency, and heads of the agency can only be removed by the president for good cause. 2 65 The president may exert political pressure on the FTC as an independent agency to take a specific action, but he is not able to direct the agency in the same way. 266 And, since the Supreme Court upheld the constitutionality of the independence of the FTC, 267 the president has never fired any commissioner. 268

Under dual antitrust enforcement, the president is thus ~~handicapped~~ [constrained] in his or her direction of antitrust policy. The FTC and DOJ jointly represent the United States in multiple international antitrust organizations, such as the Internal Competition Network269 and Competition Committee of the Organization for Economic Cooperation and Development. 270 The FTC has the power to enforce its antitrust judgments abroad,271 which further hinders the president's ability to form cohesive international policies. Further, the FTC does not distinguish between its international and domestic activities. 272 After the agency determines its enforcement policies, it "enforces them to the fullest extent of its jurisdictional authority, whether foreign or domestic."273 This could give rise to antitrust decisions that cut against the nation's best interest. Antitrust policy is a tool in the toolbox when it comes to navigating a complex global economy and political landscape. It should be used in the context of the country's overall international policies and goals.

FTC v. Qualcomm reveals how international relations and national security are intertwined with antitrust policy. 274 Opposing the district court's decision in the case successfully brought by the FTC, the DOJ argued that the antitrust enforcement action harmed Qualcomm's ability to compete and so posed a serious national security threat.275 As support, the agency cited to statements by the Departments of Defense and Energy. 276 Through various departments, the executive branch has taken strong steps to protect Qualcomm amidst the technology cold war between the United States and China. This suit threatened to do the opposite.

Qualcomm is the world's largest manufacturer of smartphone chips. 277 It is also the only American company that manufactures such chips, with China-backed Huawei as one of its biggest competitors. 278 These two companies are at the heart of a battle between the United States and China for technological dominance. 279 Qualcomm and Huawei are central to the development of 5G, the new standard network for mobile devices. 280 The outcome of the 5G race will determine whether the U.S. will continue to dominate the technology industry, or if it will "cede that control to China, which sees technological dominance as a way to become a world superpower." 281 National security experts worry that if Huawei dominates the 5G market, it could use its networks for espionage or shut down critical communications. 282 Many lawmakers have also expressed concern with China's rise in technology, fearing a Chinese surveillance state.283

In addressing these threats, President Trump blocked an attempted acquisition of Qualcomm by Broadcom in 2018.284 The president expressed concern that Broadcom, a Singaporean company, would cut off Qualcomm's R&D and enable Huawei to dominate the marketplace. 285 The transaction was blocked through the Committee on Foreign Investment in the United States (CFIUS), a committee comprised of executive branch officers such as the secretaries of the Treasury, Justice, Homeland Security, Commerce, and Defense-all directly responsible to the president.286 CFIUS reviews economic transactions by foreign entities and advises the president, who can block transactions that threaten national security. 287 CFIUS reviews have increased steadily in the last decade and Chinese transactions have accounted for the majority of the investigations.288

Outside of CFIUS, the executive branch imposed restrictions on Huawei and affiliated companies. In 2019, the U.S. Commerce Department placed Huawei on a trade blacklist based on national security concerns. 289 In announcing the action, the secretary of commerce cited a presidential directive ordering the department to be vigilant in protecting national security activities. 290 In 2020, the DOJ indicted Huawei for intellectual property theft and conspiring to steal trade secrets. 291 The international importance of the U.S. actions is underscored by its joining a movement of democracies to isolate Huawei and promote other companies as 5G providers. 292

China has also taken counteractions against U.S. technology, making any mechanism the United States has in this struggle more important. In 2018, Chinese antitrust regulators blocked Qualcomm from acquiring rival chipmaker NXP. 293 The Trump administration had lobbied the Chinese government to approve the deal, which would have allowed Qualcomm to expand into new market areas. 294 In 2019, the Chinese government ordered Chinese public institutions to replace foreign software and computer equipment with domestic suppliers within a few years. 295 In sum, both China and the U.S. have leveraged antitrust regulation to give domestic companies a strategic international competitive advantage. And this technology war is only one part of a broader strained trade relationship between the United States and China.296 The White House has reported that China's market-distorting policies and economic aggression pose a threat to the global economy.297 A 2018 report pointed to state-sponsored IP theft through cyber espionage and forced technology transfer regulations. 298 Since 2018, the two countries have had to negotiate various tariffs and trade agreements. 299

Therefore, it is highly anomalous that the FTC has exercised its prosecutorial discretion to bring an antitrust action against Qualcomm that will-in coordination with China's actions-directly benefit Huawei and aid China in its foreign policy goals, when the president and his advisors are actively pursuing exactly the opposite goal. The problem created by the struggle for technological dominance and antitrust's role in it goes beyond this single case, important as it is. As of 2018, China had nine of the world's top twenty technology companies.300 Big Tech executives have argued that breaking up Big Tech under antitrust law will only help Chinese companies dominate the industry.301 Effectively, they promote a "national champion" view: the nation needs powerful, dominant companies lest a foreign company take the helm. 30 2 Some scholars have criticized national champion policies, stating that any short-term advantages are outweighed by the harm to national innovation. 303 Regardless, the battle over the future of technology shows how antitrust regulation plays a key role in a struggle for technological, economic, and political power-and that the U.S. needs a single, president-coordinated agency to guide the process.

The problem of integrating antitrust with the rest of foreign policy is not unique to China or President Trump. President Barack Obama, like President Trump, accused the EU of pursuing antitrust or regulatory actions against Big Tech in order to help their own tech companies compete.30 4 Some countries in the EU are using state authority to promote national champions to combat U.S. tech dominance.305 For instance, France and Germany have spent significant government resources in attempts to create a European rival to U.S, cloud computing companies.306 France has additionally levied a tax on digital giants, commonly dubbed "GAFA," because it will primarily affect American tech companies Google, Apple, Facebook, and Amazon.30 7 U.S. antitrust regulators must also counter these threats to the American economy and technological dominance when exercising prosecutorial discretion over enforcement actions in the technological arena.

The competition for technological dominance is an enduring fact of our age. Moreover, technology is encompassing more and more important industries, encapsulated in the saying that "software is eating the world."308 It is thus more important today for the nation's antitrust policy to be aligned with other foreign policy actions taken by the executive branch.309 The FTC should not be able to bring antitrust actions when they can cut against the various other international efforts taken by the country.

#### That’s key to prevent Great Power War via tech leadership with China

LSE 21, London School Of Economics and Political Science, 1/28/2021, "The West needs to respond to China's bid for technology dominance: New report," London School of Economics and Political Science, https://www.lse.ac.uk/News/Latest-news-from-LSE/2021/a-Jan-21/The-West-needs-to-respond-to-Chinas-bid-for-technology-dominance-New-report

The authors also argue more needs to be done to protect and control access to Western technologies and reduce dependency on certain Chinese innovations (such as Huawei’s 5G), as well as ensuring such dependency does not recur in the future, for example with advancements in Artificial Intelligence.

The report notes the West still outperforms China in most areas of advanced technology. However, it needs to build upon institutions (eg: legal and trade organisations) that underly and contribute to technological success; prioritise technological innovation in the long-term; strengthen labour forces; and learn from China’s industrial policy, for example in long-term finance and planning.

Commenting on the report, Christopher Coker, Director at LSE IDEAS said: “The desire of states to preserve their information sovereignty is becoming a major policy issue in what is threatening to become a new Cold War. Two sharply defined technological and online systems are emerging which may well govern the future development of AI, big data, quantum computing and 5G and quite possibly determine the future shape of cyber conflict from espionage to warfare.

“Without a common strategy on technology the relationship between western states and China may become increasingly transactional, in the process diminishing their overall security and threatening their digital sovereignty. This report explains the dangers of this happening and advances concrete policy prescriptions to avoid it. Unless countries feel secure, they are unlikely to avoid making the mistakes that in the past too often ended in great power conflict.

#### The “Huawei model” is exported to allow a Chinese foothold in US infrastructure development and cyber conflict via built in “kill switches”

Morris 20, David Morris, 2/24/2020, David Morris is Vice President of the United Nations Sustainable Business Network for Asia Pacific, which advises the United Nations Economic and Social Commission for Asia and the Pacific. He chaired the UN Asia Pacific Business Forum in 2019, which was held for the first time in Papua New Guinea, and will co-chair the forthcoming Asia Pacific Business Forum. David served as an Australian diplomat for a decade. He analysed security challenges from South East Asia to the Balkans and was a major contributor to highly-respected reform proposals for the United Nations and peacekeeping. He developed new soft power strategies to support Australian business and cultural promotion around the world. “The Huawei Paradox: cyber-risks in a deteriorating geopolitical climate”, David Morris Project, https://www.davidmorrisprojects.com/post/the-huawei-paradox-cyber-risks-in-a-deteriorating-geopolitical-climate

The central security concern rests upon a theoretical proposition that Chinese technology underpinning international communications systems could be weaponised by the Chinese state. The US and its allies, amongst others, distrust the authoritarian Chinese party state and fear its growing technological and military capabilities. Despite being a private firm, observers note Huawei could be co-opted to serve the national security objectives of the Chinese government and forced to facilitate espionage or cyber-attacks (Gilding, 2020). Article 7 of China’s National Intelligence Law of 2017 is particularly cited, which requires that Chinese firms and their employees cooperate with national intelligence agencies lawfully carrying out their work (Girard, 2019). The US government has equivalent powers (Eisenstein & Halpert, 2018).

The risk of espionage would appear on the face of it to be realistic. After all, it is well documented, including in the Snowden and WikiLeaks revelations, that the US and its Five Eyes (Australia, Canada, United Kingdom and New Zealand) partners similarly engage in espionage (Snowden, 2019), including co-opting Apple, Facebook, Google and other firms to collect data (Biddle, 2020). There is no reason to believe China is not doing the same, regardless of the geopolitical climate and regardless of standard government denials. The perennial risks of espionage raise highly technical questions about capabilities of detection and protection. These are relevant questions not only in relation to Huawei, but for all telecommunications systems and the complex global supply chains for equipment and software.

The risk of cyber-sabotage is much more dependent on the state of the geopolitical climate. In a state of contest, confrontation and potential conflict, there is a risk that technically undetectable malicious code or “kill switches” are implanted into 5G networks, which could be used for cyber-attacks on critical infrastructure. Such aggressive actions might have been less likely during previous years when the US and China and other countries were cooperatively engaged in building interdependent economies. Indeed, Huawei has been intent on building its international reputation as a trusted provider of state-of-the-art technology and it would appear to be self-defeating to allow itself to be used as a platform for hostility against its customers. In the new era of geopolitical competition however, featuring new flashpoints of confrontation, economic decoupling and more aggressive positioning by both the US and China, the risks become more likely that firms such as Huawei (or indeed firms on the US side) might be co-opted or compromised for more aggressive security operations. This is not a risk specific to the firm, but a risk of hostile state action.

Looking forward, the security of 5G networks will become even more important for the connected technologies of the future. Indeed, risks will not only be generated by major power geopolitical contest but governments will also need to protect against cyber-attack from other states, terrorist organisations or rogue individuals. Whether Huawei can be enlisted as a partner in protecting against such risks, or whether it is a vector of risk, will depend upon normative perspective. Further, countries along the so-called digital silk road that are cooperating with Huawei to build “smart city” infrastructure may see more opportunities than risks, while observers from liberal democracies will be concerned about how such infrastructure might in turn be used for surveillance and social control. Whether China is exporting authoritarianism along its digital silk road rests upon the question of agency. How safe city or other programs are deployed by host governments is, at the end of the day, a matter for them rather than China (Weiss, 2019). After all, US, European and Japanese firms also export facial recognition technology that could be used to target groups or individuals but are not accused of exporting authoritarianism. This underlines the normative bias that runs through most of the narratives about Huawei.

International relations risk

The Huawei case exposes a critical gap in global governance. Inadequate rules, norms, standards and institutions exist to manage risks of globally interconnected technology. The international community is ill-prepared for the implications of the so-called “fourth industrial revolution” of big data, artificial intelligence and an internet of things, composed of connected devices and networks. The digital economy has emerged at a time of unipolarity in the international system and a weakening commitment from the US, as the dominant power, towards multilateralism. In the early stages of the digital economy, US firms such as Facebook and Google wielded significant, largely unregulated power. While the internet evolved with some private sector oversight of certain rules (such as domain names), it had no agreed set of international norms or standards and certainly no international enforcement. In the absence of rules, norms, standards and institutional enforcement, technologies generating risks have developed ahead of technical capabilities to manage those risks. Indeed, technical experts claim the complexity of telecommunications technology renders it impossible to guarantee against malicious code or backdoors in equipment (Lysne, 2018; Chang, 2020). Nevertheless, the risk of malicious action has not prevented the international community from developing – and abiding by – rules, norms, standards and institutions in numerous areas of strategic importance, from food safety to aviation. The lack of discussion about governance options for emerging technologies is therefore remarkable.

Governance of 5G telecommunications has become embroiled in the US-China geopolitical contest, as has governance of the internet. The US has opposed any expansion of the mandate of the International Telecommunications Union (ITU), one of the oldest international organisations, to govern digital communications. Meanwhile China, has developed a clear ambition to be rule-setter and norm maker in internet governance and cyber sovereignty (Schia & Gjesvik, 2017; Wang, 2020), as well as in other transformational technologies such as blockchain and its applications in finance, manufacturing, transport, food safety and public security (Cai, 2019; Stockton, 2020). Across its “digital silk road” partnerships with developing nations, China has promoted uniform standards for 5G rollout (consistent with those set by the ITU), as well as for artificial intelligence and satellite navigation systems (Chan, 2019). China will likely wield influence amongst its technological partners in the rules, norms and standards that will develop over time. China – together with firms such as Huawei - has been actively promoting its cyber governance model at World Internet Conferences, the ITU, the International Standardisation Organisation and the International Electrotechnical Commission and the two United Nations (UN) working groups, the Group of Governmental Experts and the Open-Ended Working Group. China can be expected to have the support of a significant number of developing countries.

While the US has begun to participate more actively in these forums in recent times, a fundamental clash of world views makes it unlikely consensus can be achieved. The Chinese government’s aims in cyber governance include maintenance of social stability and protection from foreign influence, deemed to require control of domestic information that is perceived as a threat to the regime. Consistent with its combination of Confucian cultural roots and Marxist-Leninist political ideology, the Chinese party states rules “by law”, in contrast with the liberal Western notions, “rule of law” and contested power. China’s approach to cyber governance is therefore focused on the state’s ability to control content, which includes network security, while Western approaches are focused on network security and not content. China proposes global standards for data security, while the US is moving to establish its so-called “Clean Network” to set standards amongst a set of “trusted” partners, which appears to ignore the global interconnectedness of supply chains and in particular data, with the emergence of cloud technologies and electronic commerce that rely upon free flow of data. China and the US also take opposing positions on governance of cyber-warfare capabilities, with China supporting (publicly at least) a UN-supervised ban, while the US prefers the status quo in which it can continue to develop its capabilities (McCarthy, 2019).

The Huawei paradox, combined with the politics of fear and blame during the Covid-19 pandemic of 2020, has amplified the different approaches of the US, with its lack of a governance framework for data security and opposition to multilateral solutions, and China, with its Cyber Security Law and support for global cyber governance. It appears the law of the cyber jungle will persist at the global level while, as will be discussed below, the European Union (EU), with its comprehensive Cybersecurity Act, General Data Protection Regulation (GDPR) and Directive on Security of Network and Information Systems (NIS), models at a regional level the most advanced attempt at rules, norms and standards to guide cyber risk management.

Economic cooperation risk

The denial of supply of advanced semiconductor chips to Huawei by the US appears likely to reinforce China’s geopolitical fears of containment and indeed historic memories of dismemberment by outside powers. Consequently, it can be expected to drive China to double down on its strategy for not only self-reliance and alternative sources of supply but indeed dominance in next generation technologies. It may take some years, but China can be expected to develop a semiconductor industry to rival the US in time. While it is impossible to prove a counterfactual, it has been suggested by Kennedy (2020) that a more “principled interdependence” between US and Chinese supply chains rather than decoupling might have sustained US semiconductor leadership, slowed China’s technological advance and offered opportunities for joint work on risk management. Coercion has been chosen over cooperation in what may yet prove to be a turning point in the deteriorating geopolitical contest between the US and China, which was being extended to impact new firms and new industries at the time of writing.

The economic costs of excluding Huawei alone are considerable. A Huawei-commissioned Oxford Economics report (2019) predicted that restricting Huawei from competitive tenders will lead to increased 5G investment costs of between eight percent to 29 percent over a decade and would have a cost to GDP in 2035 from $2.8 billion in Australia to $21.9 billion in the US. For US semiconductor firms, the export controls on sales to Chinese buyers constitute a major risk to their global business strategies. In a survey of exports in the first four months of 2018, Capri (2018) found Qualcomm relied on China for 60 percent of revenue, Micron over 50 percent and Broadcom about 45 percent. A Boston Consulting Group report forecast a full decoupling with China would reduce the US chip sector revenue by 37 percent and lower its market share to 30 percent, while China’s market share would rise from three percent to 31 per cent (Varas & Varadarajan, 2020). Further, as the geopolitical climate worsens, there is a risk that China will retaliate against US or allied firms. The Chinese government has reportedly drawn up plans to target so-called “unreliable entities”, such as Fedex, which it is alleged allowed shipments of weapons to Hong Kong and mainland China and diverted US packages addressed to Huawei (Wu, 2020). Any tit-for-tat economic coercion between China and the US will pose significant economic risks for third parties if it escalates, as expected, to include more expansive export controls, prosecutions of technology theft and restrictions on joint research and development with Chinese partners (Thomas-Noone, 2020).

Farrell & Newman (2019) coined the phrases “weaponised interdependence” for this phenomenon of a state deploying economic coercion to leverage its asymmetrical power over a global network and “chokepoint effect” to deny network access to an adversary. Now that the US has set the precedent in its campaign against Huawei, how else the tactic might be deployed is not yet clear, with fears in China, for example, that the US could target international payments through its SWIFT system (Zhao, 2020). To be sure, once the process is initiated against a firm or a sector, entire supply chains will be disrupted. The consequent evolution of a new global economy that moves away from market-led globalisation towards state-led spheres of geopolitical influence is uncertain at this point but 2020 may yet turn out to be a tipping point towards a much more geopolitically-infused international business environment. Geopolitical risk analysis is likely to receive much more attention in international business literature.

Risk assessment

The assessment of security, international relations and economic cooperation risks for 5G networks must be made in the context of not only contemporary international relations but over the life of such networks. This means planning for scenarios, including worst case scenarios. The theoretical capability for cyber-attack, for example, might not be a serious risk in some scenarios, but might become a threat in worst case scenarios in which the major powers are escalating confrontation or engaged in conflict. Following his Huawei ban, Australian prime minister, Malcolm Turnbull observed “it’s important to remember that the threat is a combination of capability and intent. Capability can take years or decades to develop … but intent can change in a heartbeat

” (Bourke, 2019). The Australian government clearly assessed the risk could become a threat, and therefore adopted a strategy of risk avoidance by banning Huawei all together. Based on distrust of the Chinese party state, the logic of this strategy would be to avoid all critical supply dependencies on China, which has indeed become a common rallying call within the US and some of its allies since.

Any qualitative assessment of risks must take into account two key concepts, likelihood and consequence. The type of political risk will depend on whether the factors generating the risk arise at the firm level, the country level or as a result of the geopolitical environment. Huawei as a firm has been assessed to pose security risks because of the nature of the Chinese party state and the risks are therefore China risks, or geopolitical risks, rather than specific to the firm itself. Equally, the international relations risks that are generated by the case appear to be not simply because of Huawei itself but arise from the diverging interests of the US and China, characterised in particular by the lack of global governance rules, norms, standards and institutions, which have been established and maintained in other sectors, as noted above, from aviation to food security. Further, in relation to economic cooperation risks, Huawei again appears to be simply the trigger case for an emerging trend in the new geopolitical contest for the US and China to deploy economic coercion, to reconfigure supply chains and indeed to reshape globalisation according to geopolitical agendas and, consequently, abandoning the neoliberal and internationalist market-led phase of globalisation that characterised previous decades.

Accordingly, the Huawei case can be assessed as a prime example of geopolitical risk and can therefore only be understood in the context of the international relations, security and consequent economic policies of the major powers. Suppliers and partners of Huawei and indeed any strategically important firms from China or the US must therefore plan to manage geopolitical risks in the current environment. There has traditionally been very little cross-fertilisation between business literature on political risk and international relations literature (Fägersten, 2015), yet this discussion demonstrates that risks for governments, firms and communities in the Huawei case are entirely bound up in questions of international relations and will require new approaches to risk management.

#### **Cyber conflict over infrastructure guarantees extinction**

Pamlin and Armstrong ’15 [Dennis and Stuart; February 2015; Executive Project Manager at the Global Challenges Foundation; James Martin Research Fellow at the Future of Humanity Institute and in the Oxford Martin School at the University of Oxford; Global Challenges Foundation, “12 Risks that threaten human civilization,” <https://www.pamlin.net/material/2017/10/10/without-us-progress-still-possible-article-in-china-daily-m9hnk>]

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3.1 Current risks

3.1.5 Global System Collapse

Global system collapse is defined here as either an economic or societal collapse on the global scale. There is no precise definition of a system collapse. The term has been used to describe a broad range of bad economic conditions, ranging from a severe, prolonged depression with high bankruptcy rates and high unemployment, to a breakdown in normal commerce caused by hyperinflation, or even an economically-caused sharp increase in the death rate and perhaps even a decline in population. 310

Often economic collapse is accompanied by social chaos, civil unrest and sometimes a breakdown of law and order. Societal collapse usually refers to the fall or disintegration of human societies, often along with their life support systems. It broadly includes both quite abrupt societal failures typified by collapses, and more extended gradual declines of superpowers. Here only the former is included.

3.1.5.1 Expected impact

The world economic and political system is made up of many actors with many objectives and many links between them. Such intricate, interconnected systems are subject to unexpected system-wide failures due to the structure of the network311 – even if each component of the network is reliable. This gives rise to systemic risk: systemic risk occurs when parts that individually may function well become vulnerable when connected as a system to a self-reinforcing joint risk that can spread from part to part (contagion), potentially affecting the entire system and possibly spilling over to related outside systems.312 Such effects have been observed in such diverse areas as ecology,313 finance314 and critical infrastructure315 (such as power grids). They are characterised by the possibility that a small internal or external disruption could cause a highly non-linear effect,316 including a cascading failure that infects the whole system,317 as in the 2008-2009 financial crisis.

The possibility of collapse becomes more acute when several independent networks depend on each other, as is increasingly the case (water supply, transport, fuel and power stations are strongly coupled, for instance).318 This dependence links social and technological systems as well.319

This trend is likely to be intensified by continuing globalisation,320 while global governance and regulatory mechanisms seem inadequate to address the issue.321 This is possibly because the tension between resilience and efficiency 322 can even exacerbate the problem.323

Many triggers could start such a failure cascade, such as the infrastructure damage wrought by a coronal mass ejection,324 an ongoing cyber conflict, or a milder form of some of the risks presented in the rest of the paper. Indeed the main risk factor with global systems collapse is as something which may exacerbate some of the other risks in this paper, or as a trigger. But a simple global systems collapse still poses risks on its own. The productivity of modern societies is largely dependent on the careful matching of different types of capital 325 (social, technological, natural...) with each other. If this matching is disrupted, this could trigger a “social collapse” far out of proportion to the initial disruption.326 States and institutions have collapsed in the past for seemingly minor systemic reasons. 327 And institutional collapses can create knock-on effects, such as the descent of formerly prosperous states to much more impoverished and destabilising entities.328 Such processes could trigger damage on a large scale if they weaken global political and economic systems to such an extent that secondary effects (such as conflict or starvation) could cause great death and suffering.

#### Second is the FTC—

#### Splits within the FTC over antitrust authority tanks effective privacy regulation---and the plan solves it

McGinnis and Sun 21, John O. McGinnis is the George C. Dix Professor in Constitutional Law at Northwestern Pritzker School of Law. McGinnis is a panelist called on to decide WTO disputes and graduate of Harvard Law School, Linda Sun is an intellectual property lawyer at Wilmerhale and former editor in chief of Northwestern Journal of Technology and Intellectual Property during her time at Northwestern Pritzker School of Law, “Unifying Antitrust Enforcement for the Digital Age”, 78 Wash. & Lee L. Rev. 305, 2021

Eliminating its jurisdiction over antitrust will also give the FTC the resources and focus to address issues of privacy. Privacy law has grown in prominence along with the rise of digital technology.310 While most Western countries have comprehensive privacy protections, the U.S. has taken a piecemeal approach, with various sector-specific and state-specific laws.311 These uneven regulations have been criticized for causing confusion for businesses and failing to adequately protect consumers. 312 In fact, 79 percent of Americans are concerned about the way their data is being used by companies and most feel that they have little to no control over how their personal data is used.313

First, eliminating FTC antitrust jurisdiction would free up resources, enabling the agency to dedicate more of its funding, personnel, and time to privacy issues.314 Second, it would streamline the FTC's mission, which is currently divided between dueling goals of consumer protection and antitrust.315 Agencies tend to perform better when they have a cohesive mission.31 6 Removing the agency's antitrust duties would resolve this problem. Narrowing the focus of the FTC's responsibilities would be a significant step in the right direction for the agency and the future of privacy law.

The FTC needs more resources to adequately address the nation's growing privacy concerns. 3 17 Currently, the FTC oversees both consumer protection-encompassing privacy-and antitrust, 318 making the FTC the chief federal agency on privacy policy and enforcement 319 and the nation's de facto privacy agency. 320 The agency has long-standing experience in enforcing privacy statutes 321 and also has special privacy assets, such as an internet lab capable of high-quality tech forensics to track invasions of privacy. 322 The FTC, however, has failed to keep pace with the massive growth of privacy concerns-a phenomenon also driven by modern technology. 323 Very few Americans feel confident in the privacy of their information in the digital age. 324 According to a 2019 study, over 80 percent of Americans feel that they have little to no control over the data collected on them by companies and the government. 325 To adequately address privacy concerns, the FTC needs more resources. 32 The agency has been explicit that it needs more manpower to police tech companies. 32 7 In requesting increased funding from Congress, FTC Director Joseph Simons said the money would allow the agency to hire additional staff and bring more privacy cases. 328 A former director of the FTC's Bureau of Consumer Protection, which houses the privacy unit, has called the FTC "woefully understaffed." 329

As of the spring of 2019, the FTC had only forty employees dedicated to privacy and data security, compared to 500 and 110 employees at comparable agencies in the U.K. and Ireland, respectively. 330 Without more lawyers, investigators, and technologists, the FTC will be forced to conduct privacy investigations less thoroughly, and in some cases, forgo them altogether. 331 Currently, the FTC's resources are spread thin across multiple missions, to the detriment of its privacy efforts.

Removing the agency's antitrust responsibilities would reallocate resources from the antitrust department to its privacy unit and other areas of consumer protection. 332 Further, it would free up the scarce time of the commissioners to oversee this essential effort. 333 This reallocation of resources is especially timely because the FTC's privacy responsibilities are expected to grow in the future. The FTC is already on its way to becoming a consumer protection agency primarily focused on privacy. 334 In its 2019 budget request to Congress, over half of the agency's budget was allocated to privacy. 335 In addition, lawmakers on both sides of the political spectrum have proposed federal privacy legislation. 336 Such legislation would expand the FTC's jurisdiction, empower it to bring more privacy actions, and increase the demands on its privacy resources. 337 Right now, the U.S. is one of the only Western countries that does not have a comprehensive federal privacy law.338 Public pressure is great from both industry and scholars to change that, which would lead to increased privacy action at the federal level. 339 Moving the FTC's antitrust duties to the DOJ would cleanly complete a readjusting of priorities that is already happening organically.

Removing its authority over competition law would also provide the FTC with organizational clarity.

Currently, the agency serves dual missions of antitrust and consumer protection. Originally, the FTC only had antitrust jurisdiction: the FTC Act banned "unfair methods of competition in or affecting commerce." 340 In 1931, the Supreme Court held that his did not include consumer protection. 341 In 1938, Congress passed the Wheeler-Lea Act, 342 which amended the FTC Act to cover "unfair or deceptive acts or practices." 343 This paved the way for the FTC's modern consumer protection mission. 344 Since then, the agency has had to pursue goals that are sometimes in conflict.

Consumer protection laws prevent companies from misleading or cheating customers. Viewed broadly, consumer protection encompasses a paternalistic social goal of protecting consumers from themselves. 345 Consumers may not wish to be educated on manipulative practices or dangerous products, but consumer protection laws aim to protect consumers despite any preference for ignorance. The FTC enforces numerous consumer protection statutes that govern bankruptcy abuse, scholarship fraud, tobacco education, and credit card accountability, among other things. 346

The FTC approaches privacy as a consumer protection issue. 34 7 Accordingly, the FTC promotes privacy interests through its Bureau of Consumer Protection. 348 At first, the agency pursued a limited deception-based approach to privacy by targeting companies that did not comply with their own privacy policies. 34 9 Since then, the FTC has broadened its approach to a harms-based inquiry against unfair handling of consumer data.350 The harms are generally linked to the rise of digital technology. For instance, consumers cannot effectively protect themselves in our dynamic, information-intense environment. 351 Some argue that digital products have led to externalities such as reduced offline interaction, addiction by design, and environmental harm in the form of electronic garbage and energy consumption. 352 Competition will result in the amount of privacy demanded by the market, which may not account for externalities and inaccurately reflect society's desires compared to the amount of privacy that people would collectively choose through legislation.353

In contrast to consumer protection law, antitrust law aims to preserve "free and unfettered competition." 354 The foundation of antitrust law is now understood to be protecting consumer welfare that flows from economic efficiency. 355 Antitrust promotes the free market by outlawing monopolization and unreasonable restraints of trade.356 Rather than the social goals of privacy and protection from deception promoted by consumer protection, antitrust pursues economic efficiency. 357

Consumer protection and free competition can work against each other. Consumer protection regulation has been empirically proven to introduce barriers to entry, especially for small companies.358 Environmental, safety, and health regulations protect consumers while inhibiting the free market.359 Consider a specific example of the tension between consumer protection and competition. The Fair Credit Reporting Act360 provides an important service to consumers by protecting the fairness, accuracy, and privacy of personal information kept by credit reporting agencies.361 At the same time, these protections introduce high compliance costs that have limited entry in the credit reporting industry.36 2 The four incumbents that dominate the market were established before the Act was passed.363

Safeguarding privacy as an aspect of consumer protection provides similar examples of tensions with promoting competition. In the U.S., the Children's Online Privacy Protection Rule (COPPA) establishes strict requirements on websites that target children.36 4 These limitations guard the privacy of children but have also led to less innovation in children's websites and apps in the country. Many apps targeted at children are developed in countries that have weaker privacy protections for children, such as Ukraine.365 The passage of General Data Protection Regulation (GDPR),366 a sweeping privacy legislation in Europe, led to increased control by consumers over their personal data.36 7 Simultaneously, it decreased competition among technology vendors and shrank overall business.368 The anticompetitive effects are unsurprising, given that the average cost of compliance with the regulation was £1.67 million.369 Additionally, privacy regulation in the U.S. focuses on regulating interfirm data transfers over intrafirm uses, privileging large tech companies that are able to commercialize user data on their own. 370 This may have the effect of further entrenching monopolists, contrary to the goals of antitrust. This conflict between consumer protection, including the protection of privacy, and antitrust poses a problem of incompatible missions for the FTC.

#### Effective FTC privacy regs are key to telehealth

Hall, 14

(Joseph L. Hall (joe@cdt.org) is chief technologist at the Center for Democracy and Technology, in Washington, D.C. Deven McGraw is director of the Health Privacy Project at the Center for Democracy and Technology "For Telehealth To Succeed, Privacy And Security Risks Must Be Identified And Addressed,"HEALTH AFFAIRS 33, NO. 2 (2014): 216–221 <https://www.healthaffairs.org/doi/pdf/10.1377/hlthaff.2013.0997> NL)

The success of telehealth could be undermined if serious privacy and security risks are not addressed. For example, sensors that are located in a patient’s home or that interface with the patient’s body to detect safety issues or medical emergencies may inadvertently transmit sensitive information about household activities. Similarly, routine data transmissions from an app or medical device, such as an insulin pump, may be shared with third-party advertisers. Without adequate security and privacy protections for underlying telehealth data and systems, providers and patients will lack trust in the use of telehealth solutions. Although some federal and state guidelines for telehealth security and privacy have been established, many gaps remain. No federal agency currently has authority to enact privacy and security requirements to cover the telehealth ecosystem. This article examines privacy risks and security threats to telehealth applications and summarizes the extent to which technical controls and federal law adequately address these risks. We argue for a comprehensive federal regulatory framework for telehealth, developed and enforced by a single federal entity, the Federal Trade Commission, to bolster trust and fully realize the benefits of telehealth. Telehealth involves the use of telecommunication technologies to prevent and treat illness and promote the health of individuals and populations. Although telehealth has particular benefits for rural and underserved populations, it is increasingly recognized for its potential to control costs while providing real-time tools to promote wellness, prevent disease, and enable the home management of chronic conditions. Telehealth frequently involves bidirectional, digital collection and communication of sensitive health information among health care providers and patients. For a medical device to qualify as a telehealth device, there must be communication of health information from the device over a network. For example, a glucose monitor becomes a telehealth device when it sends readings to a provider or a provider’s information system over an information network. Similarly, some generic communications technologies—such as videoconferencing—are frequently used to communicate health care information and thus become telehealth tools in those settings. Telehealth devices include mobile software applications (apps) in addition to hardware. This article focuses on network-enabled telehealth devices where a device collects information from the patient (for example, measuring a function of the body or scanning the environment for safety risks) and then transmits data to a health care provider. To realize telehealth’s full potential, however, patients and providers must trust telehealth systems to keep personal information private and secure. We identify privacy and security risks of telehealth systems, summarize the extent to which technical controls and current federal laws do—and do not—adequately address those risks, and include recommendations for building and maintaining public trust in telehealth systems through a comprehensive regulatory framework developed and enforced by the Federal Trade Commission (FTC). Potential Privacy Risks Privacy risks of telehealth involve a lack of controls or limits on the collection, use, and disclosure of sensitive personal information. Sensors that are located in a patient’s home or that interface with the patient’s body to detect safety issues or medical emergencies may inadvertently collect sensitive information about household activities. For instance, home sensors intended to detect falls may also transmit information such as interactions with a spouse or religious activity, or indicate when no one is home. Routine transmissions from a medical device may be collected and stored by the device or app manufacturer, not just the health care provider. A mobile health app may be financed by sharing potentially sensitive data from the app with third-party advertisers that target ads to patients based on app use. Such collection, use, and disclosure of information may be beyond what patients reasonably expect given anticipated uses of the technology. For example, in 2011 the popular fitness device Fitbit inadvertently exposed users’ self-reported sexual activity, failing to acknowledge that some forms of physical exertion may be sensitive information.1 Patients give consent for having a device implanted or sensors embedded, or for using a health app. However, overreliance on consent too often results in weak privacy protections. Patients frequently do not read or fully understand privacy policies, and consent shifts the burden of privacy protection to the patient, who may not be able to make meaningful privacy choices.2 Privacy Controls Privacy is typically protected by laws or operating policies that implement Fair Information Practice Principles (FIPPs). FIPPs are widely accepted practices, including the ability to access one’s own health information and request corrections; limitations on information collection, use, and disclosure; and reasonable opportunities to make choices about one’s own health information. Providing people with choices for information sharing is only one of the FIPPs, bolstered by others that require data holders to establish and abide by contextually appropriate limits on data access, use, and disclosure. The Health Insurance Portability and Accountability Act (HIPAA) of 1996 is one of several sectoral federal laws designed to implement these principles. Current laws, however, do not adequately cover the telehealth environment, as discussed in later sections. Thus, there is no guaranteed right (and often little capability) for individuals to request copies of information collected by apps or home monitoring devices. Information use and disclosure is largely determined by technology companies, with few (if any) legal limits or meaningful opportunities for individuals to control information flow.3 Potential Security Risks Detailing the security risks and appropriate security controls for telehealth systems involves specifying what kinds of security threats they should protect against. In telehealth delivery models involving provider-to-provider communication, the entities at both ends are typically required by HIPAA to implement appropriate security safeguards, such as authentication and data encryption measures (see “Security Controls” below). However, in telehealth models where one end of the communication (“endpoint”) is the patient (for example, an implantable device that sends signals to a physician, or a mobile health app on a patient’s cell phone), that endpoint falls outside the controlled and supervised environment of a HIPAA-regulated clinical care setting, magnifying existing privacy and security concerns. For a typical telehealth system where a provider communicates with a patient, relevant threats include breach of confidentiality during collection of sensitive data or during transmission to the provider’s system; unauthorized access to the functionality of supporting devices as well as to data stored on them; and untrusted distribution of software and hardware to the patient. Although we are unaware of direct harm to patients associated with a security flaw in a telehealth system, there have been academic demonstrations of such problems. For instance, certain insulin pumps have been shown to be vulnerable to hacking.4 There also have been instances where unauthorized software, such as file-sharing software installed by a health care employee, led to a breach of health information and medical identity theft.5 Security Controls A number of existing technical controls can protect against these security risks.6 Data encryption—where data are electronically “locked” using complex mathematics and encryption “keys”—can ensure that if an attacker gains access to the raw data, those data will be meaningless. There are various functional types of data encryption: while data are “at rest” (being stored) or “in transit” (being transmitted), and from “end to end” (a type of encryption that does not depend on the state of the data). At-rest and in-transit encryption typically rely on encryption methods provided by operating systems and browsers. These methods are usually external to the telehealth software. With end-to-end encryption, encryption may be directly incorporated into the telehealth application. Encryption of data at rest ensures that when an attacker bypasses access controls, the data are meaningless. Encryption of data in transit guarantees that data are meaningless if a transmission is intercepted. In “end-to-end” encryption, unencrypted information is only ever available at the two endpoints and never between.7 With encryption, anyone with the correct key can retrieve meaningful data. Access to the underlying information system, however, can be further controlled using authentication and access control mechanisms, which restrict access to information based on the identity of the person accessing the data or his or her role within an organization. In addition, medical and consumer devices typically used by patients for telehealth applications can themselves pose serious risks, as the devices contain numerous security flaws and are constantly under attack from threats such as malware.8 Mobile platforms control this by prohibiting the installation of software that has not been examined and approved. A final security control for telehealth software and devices involves initially distributing them to patients in a face-to-face setting. This enables the provider to establish the identity of the patient and authenticate the device she or he is using. This way, providers know they are not introducing security risks by accepting data from a potentially unsafe patient device (from a security, not a health risk, standpoint), and patients have some assurance about the quality of the hardware and software, because they interact with an experienced provider to obtain, install, and configure the device. HIPAA Protections HIPAA privacy and security regulations provide protections for identifiable health information, but only when it is collected and shared by “covered entities”—health care providers who bill electronically using HIPAA standards, health plans, and health care clearinghouses.9 When it applies, HIPAA’s Privacy Rule establishes limits on the use and disclosure of identifiable health information, and its Security Rule establishes technical, physical, and administrative safeguards to be adopted to protect electronic identifiable health information. For example, encryption of data at rest and in transit is an “addressable implementation specification” under the Security Rule, meaning that HIPAAcovered entities are expected to implement it unless it is not “reasonable and appropriate” to do so.10 In addition, the regulation states, providers are required to adopt identity management protocols and access controls. In the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, Congress extended HIPAA to “business associates,” entities that “create, receive, maintain, or transmit” identifiable health information to perform a function or service “on behalf of” a covered entity.11 Whether a vendor of a patient-facing telehealth technology is a HIPAA business associate depends on whose interests are being served by the technology. Relevant questions include the following: Who provides the technology to the patient (for example, is it a direct-to-patient transaction, or is the technology provided by the doctor)? Who benefits from the technology being offered? Who is responsible for the day-to-day operation of the technology (an indication of who is ultimately responsible)? And who controls the information generated by the technology? Mere connectivity between a device and a health care provider does not render the device manufacturer a business associate of that provider.12 Other Federal Protections Given HIPAA’s limited applicability to patientfacing telehealth systems,13 its protections will not apply to information collected by most digital tools provided to patients. Additional federal laws provide some protections, however. In section 13407(f)(2) of the HITECH Act, Congress established breach notification requirements for personal health records. The requirements are overseen by the FTC. Section 13400(11) of the HITECH Act defines a personal health record as an electronic record of identifiable information “drawn from multiple sources and…managed, shared, and controlled” by the patient. Some tools of telehealth, such as network-enabled medical devices, would not fit this definition, as they do not draw information from multiple sources and are not typically controlled by the patient. As a result, the HITECH breach notification provisions will not apply. The FTC also has authority under the Federal Trade Commission Act to prevent, and seek redress for, unfair or deceptive acts or practices.14 The FTC has used this authority frequently to penalize consumer-facing, for-profit companies for failing to abide by commitments regarding data use made in privacy policies and less frequently to stop unfair practices involving data use and collection.15 As a result, patients using apps and other telehealth devices must largely rely on company policies regarding uses of data, typically found in a company’s privacy policy or the license agreement. These policies are frequently offered to users unilaterally: Accept the terms or don’t use the product. Unfortunately, in the case of medical devices, patients often do not have a choice. The FTC also expects companies to implement reasonable security safeguards and has acted in cases of unfair design, unfair default settings, and unfair data security practices that cause substantial injury to consumers and are not offset by other benefits.15 Because the FTC does not set detailed requirements for either data privacy or security, protections for telehealth technologies not covered by HIPAA are largely dependent on the technology vendor’s discretion. If a telehealth technology qualifies as a medical device, the Food and Drug Administration (FDA) may also regulate it. The FDA does not directly address privacy issues but focuses on security to the extent that it affects medical device safety. (The FDA regulation of mobile medical apps is discussed in greater detail elsewhere in this issue.)16 In June 2013 the FDA issued draft guidance on “management of cybersecurity in medical devices,”17 which urges manufacturers to develop security controls to maintain information “confidentiality, integrity and availability.” In August 2013 the FDA finalized guidance regarding radio frequency wireless technology in medical devices.18 And in September 2013 the FDA issued broad guidance on the regulation of mobile medical apps, clarifying that some types of mobile medical apps will be considered medical devices and regulated by the FDA as such.19 Through these guidance documents, the FDA is establishing a federal baseline for security in telehealth, but the FDA’s authority has limits. The FDA oversees only technologies it considers to be medical devices and focuses only on security protections designed to ensure safety. It does not focus on privacy safeguards that enforce rules or policies regarding collection, use, and disclosure of potentially sensitive health information. Building Trust A comprehensive federal policy framework protecting the privacy and security of information collected by telehealth technologies is needed to safeguard patients and bolster public trust. Such protections should be consistent with HIPAA, to ensure a rational and predictable policy environment, but they also should respond to threats to privacy and security that are more characteristic of patient- and consumer-facing technologies. Specifically, policy should address issues such as deficiencies in security safeguards, reliance by app companies on advertising within the apps, and consumers’ lack of access to their information. Such policies should be tailored to address the unique telehealth risks we have identified here. The policies should cover data collection, use, and disclosure, for both the intended purpose of the technology and any secondary data uses, such as for analytics. They should also be flexible enough to support innovation. There are a number of challenges to crafting such a policy framework. Privacy and security concerns sometimes can conflict with practicality for patients and industry. Privacy and security controls that do not anticipate the needs and preferences of the intended users are less likely to be deployed. For example, only half of iPhone users lock their devices with a passcode, which prompted Apple to integrate a fingerprint reader into newer models of the iPhone to make it easier to lock the device.20 This tension between operational practicality on the one hand and privacy and security on the other also exists in other sectors, such as telecommunications and banking. Both the Cable TV Privacy Act of 1984 and the Telecommunications Act of 1996 prevent the disclosure of personal information without consent and also provide some FIPPs-like protections, while balancing the business and operational needs of cable and telecommunications providers by al lowing the sharing of personal information if the customer fails to opt out of such sharing.21,22 In banking, the Fair Credit Reporting Act of 1970 and the Gramm-Leach-Bliley Act of 1999 heavily regulate what credit reporting agencies and financial services companies can do with personal information, providing for conspicuous and regular notice of privacy practices and rights of correction and transparency for consumers. However, these laws also favor an opt-out approach for sharing personal information—allowing data to flow by default to other companies unless the customer specifically opts out.23,24 Unfortunately, no federal agency currently has authority to enact privacy and security requirements to cover the telehealth ecosystem. We argue that Congress must establish general standards for data protection in telehealth and vest primary authority for telehealth privacy and security oversight with one federal agency. The Department of Health and Human Services (HHS), with experience in implementing HIPAA and overseeing US health programs, is an obvious candidate. However, no HHS office or agency has experience with the privacy and security risks introduced by consumer-facing commercial technologies, and, as noted above, the FDA’s focus is on safety, not privacy. The ideal agency should have a track record of experience on privacy and technical security issues and be nimble and supportive of innovation. The FTC, with its growing technical expertise and long experience in evaluating the privacy risks of consumer-facing technologies, is the agency within the federal government most equipped to regulate information privacy, including within networked telehealth systems. With respect to telehealth, Congress should give the FTC two-part authority. First, building on the Department of Commerce’s 2010 outline for “voluntary enforceable codes of conduct” with respect to consumer privacy,25 the FTC should facilitate development of voluntary codes of conduct by telehealth manufacturers and other interested stakeholders that include baseline privacy and security protections. Because the telehealth environment is rapidly evolving, involvement of manufacturers and other stakeholders in developing privacy and security codes of conduct is critical. The FTC, under its existing authority to regulate deceptive and unfair practices, can enforce these protections among telehealth manufacturers that commit to adopting them. To induce industry to develop and adopt these codes of conduct, the FTC should provide a safe harbor from enforcement action for those activities governed by the codes. To ensure meaningful protections, safe harbor should be granted only to codes that the FTC deems to be sufficiently consumer protective.

#### US telehealth solves global pandemics

Price-Smith et al., PhD, Chair of the Political Science Deparment, Colorado College, advisor for the U.S. Director of National Intelligence (DNI), and the US Department of Defense, served as advisor to the United States Institute of Peace, the United Nations Development Program, the World Bank, the US Environmental Protection Agency, ‘16 (Andrew, Joseph M. Rosen, M.D., Professor of Surgery, Geisel School of Medicine, Luis Kun, PhD, Professor of National Security Affairs at the Center for Hemispheric Defense Studies (2011-2015) at the National Defense University, Robyn E. Mosher, Geisel School of Medicine, Dartmouth College, Elliott Grigg, Anesthesiology and Pain Medicine University of Washington, Seattle Children’s Hospital, Christian Macedonia, Lancaster General Health, Penn Medicine, Julien Klaudt-Moreau, Geisel School of Medicine, Dartmouth College, “Cybercare 2.0: meeting the challenge of the global burden of disease in 2030,” Health and Technology, June, Volume 6, Issue 1, pp 35–51)

2.6.1 Surveillance and contact tracing As EVD began to spread across the affected West Africa region in 2014, identifying cases and then tracking them became paramount in stemming the tide of the infection. In contrast to many disasters, which are bounded, pandemics based on infections fail to recognize international borders or other normal boundaries. In order to contain this disease as it spread, we would have required scalable and sustained responses. These include: 1) Early recognition, coordination, and collaboration among affected nations and regions; 2) Understanding the disease penetration and transmission dynamics with surveillance and contact tracing; 3) Utilization of existing technologies in information processing and communication (such as mobile phones) to aid in better understanding the tempo and spread of the disease. These systems, coupled with research activities, early diagnostics, tracking and mapping capabilities (especially in a mobile population), risk factor assessment and treatment effectiveness, become essential to decision-makers in implementing effective control and treatment measures [45]. Given the penetration of mobile phones in Africa, individuals seeking information about the disease, including where to refer themselves or family members for care, could provide important information regarding the potential spread of the illness. Geographic location of callers is often mandated to be available to emergency services in times of crisis. However, in humanitarian context situations, such processes may not have the regulatory precedent to be implemented, potentially hindering the response effort. During the EVD outbreak, Sierra Leone deployed caller location services within its 117 Ebola Response Centers. Two projects were implemented concurrently: 1) Cell tower locations were supplemented by information collected by 117 call operators, and 2) Real-time location services of callers were deployed rapidly to support emergency services’ response efforts. Privacy issues did occur, though these were in part addressed with software solutions [46]. Typically, once a potential contact with a patient occurs, tracking them is a paper-based system involving data collection forms, data aggregation from local sites, data entry into a database, data aggregation on a regional scale, data review and reporting, and finally report submission to national decision-makers. Such a process can be especially challenging not only within the context of the area from which the epidemic surged, but also given the 21-day incubation period of EVD. In 2014, a team designed and implemented a smartphone-based contact tracing system that was linked to data analysis and visualization. The project, started in Conakry, Guinea, eventually expanded into five prefecture regions over six months, tracking more than 9000 individuals. The system was based upon the CommCare mobile application and was integrated with Tableau, a business intelligence software using protocols publically available from the CDC as well as the WHO. The contact software was designed to not only intake information on affected persons, but also to track their movements using time stamps and data location. Dashboards helped to display the information and performance of the collection methodology. Data validation occurred with test comparisons with paper-based systems, eventually approaching 90 % agreement [47]. 2.6.2 Education and information dissemination Health information technology (HIT) using electronic health records (EHR) has developed with mostly passive utilization for providers to get real-time information on medications, laboratory and imaging results, and to provide a method of documenting care. Its use in emerging illnesses or disasters such at EVD is less well described. Once available, providers did embrace HIT in caring for patients suffering from the EVD disease. The WHO and the CDC actively disseminated current information on diagnosis, treatment and supportive care, such as the proper use of personal protective equipment. However, while EHRs helped support individual episodes of care, they proved less helpful in sharing that information during the outbreak. One problem that occurred was the concept of “technology-induced error” where critical data that may have proved useful in tracking the disease or evaluating it on a population basis was hindered by the non-standard placement of the information in the EHR [48]. Symptom monitoring apps and other mobile applications were less well developed during EVD, with the exception of outbreak tracking maps. Ushahidi did develop a mapping tool to track the disease using crowd-sourced data. Also, the International Red Cross sent two million text messages each month in an effort to spread current knowledge [49]. One challenge in the development and usage of such tools, however, stems from mobile phone penetration in Africa. While mobile phone use is extensive throughout much of Africa, smartphone availability is less so, estimated in January 2014 at 12 % [48]. ClinPak is a US-developed, Nigeria-implemented mobile EMR system designed to track a patient’s medical history, active medical problems and associated treatments in a point-of-care platform. It has been successfully implemented in Nigeria for improving maternal health, but found a new use during the EVD outbreak. Important especially early in the outbreak was information dissemination; ClinPak supported the development of other mobile apps to help disseminate EVD information [49]. Potential next steps that might be useful to streamline the use of EHRs and apps include: 1) Standardize the methodology in programming data in EHRs and apps; 2) Create and improve apps’ functionality; 3) Remove constraints on data input for contextualized diagnosis (e.g., using the open.fda.gov model), and 4) Make information and usage available at point of care [50]. 2.6.3 Discussion According to the CDC, current estimates put the total number of cases at approximately 24,797 with about 8764 deaths since March 2014 [51, 52]. While the number of new cases has flattened out since the peak early summer of 2015, the crisis continues nearly two years after it began. Many fault the WHO for its mismanagement of the crisis during its earlier stages. Had there been a more concerted international effort at the onset of the crisis we may not have seen such a dramatic increase in the total number of cases. It is important to note that many of the cases seen outside of West Africa were the result of healthcare workers returning to their country of origin. Cybercare could have tracked all of the cases and allowed a more timely response to the disease outbreak. With communicable diseases, we do not have the luxury to evacuate the patients in large numbers. We need to isolate diseased patients, treating them in place with either isolation (if they are infected) or quarantine (if they have had contact with infected individuals). Cybercare provides the electronic tools to allow this treatment to happen. The use of telemedicine and robotics is crucial to treating at a distance

, allowing quarantine and isolation of individuals who are infected or exposed to the disease. If we transport these patients, we risk infecting the rest of the country or the world. This is what we began to see in Ebola in West Africa where individuals traveled out of the country with this highly deadly communicable disease. In the future we need a healthcare system in place to treat pandemics when Ebola or Middle East Respiratory Syndrome coronavirus (MERS-CoV) infect individuals who travel internationally. The system will need to be able to stop the spread of disease with vaccines (i.e., make vaccines rapidly with new technologies to produce large quantities in weeks rather than months; deliver vaccines with robotic-controlled drones); treat exposed or infected patients with isolation or quarantine; and track patients with both communicable disease as part of the pandemic, and non-communicable chronic diseases like diabetes that require ongoing treatment. The system should also anticipate a pandemic by examining susceptible populations, determining if any individuals are infected, and treating them early. Prior pandemics such as SARS had lower transmission and death rates than Ebola, whose mortality is extremely high. Cybercare is ideal for remotely treating a pandemic because it provides telemedicine for treatment at a distance, along with aggressive task shifting, and the technology for advanced quarantine and isolation with robotics. As medical responders set up 11 hospitals in West Africa for Ebola, we could have positioned key technologies. An example: IVs were crucial in Ebola to reduce the fatality from 80 to 40 %. Yet, placing an IV in an Ebola patient is very dangerous for a pandemic provider (personal quote, Tom Crabtree). We could have placed explosive ordnance robots at those hospitals as remote-controlled nurses. Robot nurses already exist [53]. We need to teach the robots to place intravenous lines and care for patients in situations where the risk of provider infection is so high — this will certainly be possible before 2030. Travel is very dangerous in a pandemic of Ebola or even SARS. Patients need to know and believe that by staying in place they will receive the best care possible. This will protect those across borders from becoming infected. In 2030, our response to pandemics will dramatically improve with Cybercare. 3 Conclusion: the way forward Cybercare will provide the foundation for healthcare delivery in the future. It is based on seven pillars of information technology (genomics; telemedicine; robotics; simulation, including virtual and augmented reality; AI; the EMR; and smartphones) that support three key paradigms. We will shift care from treatment to prevention, from specialist to generalist, and from the hospital to the home. Cybercare could help enhance private health and public health; address the GBD with treatment for communicable illnesses; and help the aging population cope with their chronic illnesses in the developed world. Cybercare is already accomplishing many of the goals we outlined almost a decade ago [3]. Medical providers are available in some drugstores (we envisioned this in 2008, and it is now a reality), and via telemedicine (this was in early stages in 2008, and is now widely implemented). Many patient-monitoring devices and cell phone apps exist to collect health data for the use of both patients and providers. Over the next 15 years, we will see a dramatic acceleration in the use of technology in health care. By 2030, we expect that much of what we have predicted in this paper will be in place in the US healthcare system and in the Global healthcare environment. Telemedicine is the oldest, best-known Cybercare technology, but that is rapidly changing as technologies evolve and merge. For example, telemedicine is now being done on a smartphone. New technologies will develop that enhance this model. Information fusion and techniques for management (of big data, information, knowledge and wisdom) promise to play a central future role in the prevention and detection of the burden of disease as well as its remediation. Oracle has implemented this technology in Indonesia, Singapore, and Australia [26].

#### **Disease 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.**

# 2ac

#### 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.

#### Degrowth can’t stop warming—there’s lag between emissions and temperature rise.

Kolbert 17—(staff writer focusing on science news, member of the Bulletin of the Atomic Scientists' Science and Security Board). Kolbert, Elizabeth. 2017. “Can Carbon-Dioxide Removal Save the World?” The New Yorker. November 13, 2017. <https://www.newyorker.com/magazine/2017/11/20/can-carbon-dioxide-removal-save-the-world>.

Carbon dioxide was “discovered,” by a Scottish physician named Joseph Black, in 1754. A decade later, another Scotsman, James Watt, invented a more efficient steam engine, ushering in what is now called the age of industrialization but which future generations may dub the age of emissions. It is likely that by the end of the nineteenth century human activity had raised the average temperature of the earth by a tenth of a degree Celsius (or nearly two-tenths of a degree Fahrenheit). As the world warmed, it started to change, first gradually and then suddenly. By now, the globe is at least one degree Celsius (1.8 degrees Fahrenheit) warmer than it was in Black’s day, and the consequences are becoming ever more apparent. Heat waves are hotter, rainstorms more intense, and droughts drier. The wildfire season is growing longer, and fires, like the ones that recently ravaged Northern California, more numerous. Sea levels are rising, and the rate of rise is accelerating. Higher sea levels exacerbated the damage from Hurricanes Harvey, Irma, and Maria, and higher water temperatures probably also made the storms more ferocious. “Harvey is what climate change looks like,” Eric Holthaus, a meteorologist turned columnist, recently wrote. Meanwhile, still more warming is locked in. There’s so much inertia in the climate system, which is as vast as the earth itself, that the globe has yet to fully adjust to the hundreds of billions of tons of carbon dioxide that have been added to the atmosphere in the past few decades. It’s been calculated that to equilibrate to current CO2 levels the planet still needs to warm by half a degree. And every ten days another billion tons of carbon dioxide are released. Last month, the World Meteorological Organization announced that the concentration of carbon dioxide in the atmosphere jumped by a record amount in 2016. No one can say exactly how warm the world can get before disaster—the inundation of low-lying cities, say, or the collapse of crucial ecosystems, like coral reefs—becomes inevitable. Officially, the threshold is two degrees Celsius (3.6 degrees Fahrenheit) above preindustrial levels. Virtually every nation signed on to this figure at a round of climate negotiations held in Cancún in 2010. Meeting in Paris in 2015, world leaders decided that the two-degree threshold was too high; the stated aim of the climate accord is to hold “the increase in the global average temperature to well below 2°C” and to try to limit it to 1.5 °C. Since the planet has already warmed by one degree and, for all practical purposes, is committed to another half a degree, it would seem impossible to meet the latter goal and nearly impossible to meet the former. And it is nearly impossible, unless the world switches course and instead of just adding CO2 to the atmosphere also starts to remove it. The extent to which the world is counting on negative emissions is documented by the latest report of the Intergovernmental Panel on Climate Change, which was published the year before Paris. To peer into the future, the I.P.C.C. relies on computer models that represent the world’s energy and climate systems as a tangle of equations, and which can be programmed to play out different “scenarios.” Most of the scenarios involve temperature increases of two, three, or even four degrees Celsius—up to just over seven degrees Fahrenheit—by the end of this century. (In a recent paper in the Proceedings of the National Academy of Sciences, two climate scientists—Yangyang Xu, of Texas A. & M., and Veerabhadran Ramanathan, of the Scripps Institution of Oceanography—proposed that warming greater than three degrees Celsius be designated as “catastrophic” and warming greater than five degrees as “unknown??” The “unknown??” designation, they wrote, comes “with the understanding that changes of this magnitude, not experienced in the last 20+ million years, pose existential threats to a majority of the population.”) When the I.P.C.C. went looking for ways to hold the temperature increase under two degrees Celsius, it found the math punishing. Global emissions would have to fall rapidly and dramatically—pretty much down to zero by the middle of this century. (This would entail, among other things, replacing most of the world’s power plants, revamping its agricultural systems, and eliminating gasoline-powered vehicles, all within the next few decades.) Alternatively, humanity could, in effect, go into hock. It could allow CO2 levels temporarily to exceed the two-degree threshold—a situation that’s become known as “overshoot”—and then, via negative emissions, pull the excess CO2 out of the air. The I.P.C.C. considered more than a thousand possible scenarios. Of these, only a hundred and sixteen limit warming to below two degrees, and of these a hundred and eight involve negative emissions. In many below-two-degree scenarios, the quantity of negative emissions called for reaches the same order of magnitude as the “positive” emissions being produced today. “The volumes are outright crazy,” Oliver Geden, the head of the E.U. research division of the German Institute for International and Security Affairs, told me. Lackner said, “I think what the I.P.C.C. really is saying is ‘We tried lots and lots of scenarios, and, of the scenarios which stayed safe, virtually every one needed some magic touch of a negative emissions. If we didn’t do that, we ran into a brick wall.’ ”

#### BUT—growth solves via carbon capture.

Page 19—(BA in administration from University of Canberra, studied economics of climate change at Cambridge as a British Council Chevening Fellow, former energy advisor for the Australian Public Service). Page, Brad. 2019. “Why Carbon Capture Could Be the Game-Changer the World Needs.” World Economic Forum. March 22, 2019. <https://www.weforum.org/agenda/2019/03/why-carbon-capture-could-be-the-game-changer-the-world-needs/>. \*\*\*Added “degrees” for readability\*\*\*

The scale of the challenge is unprecedented. The world economy is set to double in the next 20 years, while we need to cut our emissions by more than half in that time and become net-zero by mid-century. Limiting global warming to 1.5 [degrees]˚C requires monumental action. We need to change the way we live, the way we work, the way we farm and eat, and the way we consume energy. Implementing this enormous shift will require substantial new investments in low-carbon technologies and efficiency. The IPCC SR 15 report finds that if the 1.5˚C goal is to be met, investments in low-carbon energy technology and energy efficiency will need to increase by roughly a factor of five by 2050 compared to 2015 levels. But the sad fact is the world is dangerously off-track. The current trajectory, as defined by the pledges and targets that governments have made under the Paris Agreement, would limit warming to about 3.0 [degrees]°C. Global CO2 concentration hit an all-time high in 2018. This is despite the record renewable generation capacity installed and operating globally, suggesting that renewables - while part of the solution - are not the complete solution. Indeed the IEA finds that of the 38 clean-energy technologies we need to meet our climate targets, only four are currently on track. Energy efficiency improvements have slowed down, and progress on key technologies like carbon capture and storage (CCS) remains stalled. Policymakers need to respond to these challenges with urgency, enabling policies that drive investment and clean-energy deployment in the short-term, while demonstrating sustained commitment to a low-carbon environment for success in the long-term. Growth: Decarbonisation can be a driver for prosperity But what sounds daunting might well be an unprecedented opportunity for economic growth. Former heads of governments and climate leaders agree: Decarbonisation is also the growth story of the 21st century. The New Climate Economy found that bold climate action can deliver $26 trillion in economic benefits through 2030 (compared with business-as-usual), while generating more than 65 million jobs and avoiding more than 700,000 premature deaths from air pollution in 2030. These findings should not go unnoticed, and governments should be looking for ways to capture this potential and translate it into actual economic growth. Technology neutrality: Let’s not discard any solutions We need ambition - but we also need cool heads. If we continue to perceive this challenge along the lines that have divided us for so long — as a tug-of-war, in effect — we will lose as a collective. One of the key technologies that is off-track in the IEA’s clean energy monitor is carbon capture and storage (CCS), a set of technologies that prevents carbon dioxide emissions from entering the atmosphere and safely stores them deep underground in dedicated geological storage. CCS first started to gain recognition in the 2000s as a means of capturing emissions from the dirtiest source of energy: coal-fired generation. This perception, that CCS is about delivering ‘clean coal’, coupled with the fact that its deployment globally has been slower than predicted has hung an albatross around its neck. The truth is that CCS has much wider applications. It remains the only technology that can deliver deep emissions reductions in hard-to-abate industrial sectors such as steel, fertiliser and cement. Decarbonising these sectors is not simply about electrifying them with zero-carbon power; most of these processes require either carbon in their chemistry or high heat input, neither of which electricity is able to provide. As global emissions continue to rise we are likely to overshoot our climate goals, and therefore carbon dioxide will need to be permanently removed from the atmosphere and used or stored. In fact, all four scenarios outlined in the IPCC SR15 report rely on carbon removal, with three of the four scenarios foreseeing significant amounts of carbon capture and storage. CCS can also have a role to play in generating power, as most emissions linked to energy infrastructure are already essentially locked-in. Coal-fired power plants, which account for one-third of energy-related CO2 emissions today, represent more than a third of cumulative locked-in emissions to 2040. Most of these plants are in Asia, where average coal plant is just 11 years old with decades left to operate. Looking ahead, more than 200 GW of coal capacity is under construction globally with 300 new plants to come online in the next few years in India and China alone. CCS is the only technology that can truly decarbonise these facilities. In OECD countries, renewable intermittency poses a real challenge to grid operators. Zero-emission electricity is central to our future but balancing services are likely to continue to be dominated by gas-fired plants for several decades yet. CCS is necessary. High cost is often touted as the reason behind CCS’ failure to scale up. Based on ‘micro’ measurements such as the levelised cost of electricity, power generation that incorporates CCS may appear more expensive compared to other sources. However, modelling by climate organizations such as the IPCC and the UK Committee on Climate Change repeatedly demonstrates that at a ‘macro’ system level - which surely should matter more from a societal point of view - achieving deep decarbonisation would be extremely difficult and costly, if not outright impossible, without CCS. At a micro level, while the cost of CCS could be more than $100 per tonne of CO2, it can also be as low as $20 a tonne for those applications where CO2 removal is an inherent part of the production process, such as in natural gas processing. Within that range, the IEA finds that as much as 450 million tonnes of CO2 can be captured and stored with a commercial incentive as low as $40 per tonne of CO2. Harnessing these low-cost opportunities could provide a solid foundation for scaling up CCS deployment. Technology innovation will also help. In the US, an emissions-free natural gas power plant began test operations in 2018, which has carbon capture built in as part of the combustion cycle aiming to compete with conventional combined cycle generation. If proven in practice, this could be a game-changer. Justice: Investing in a fair transition and new energy economy In the past, vast changes in the economy have led to socioeconomic displacements. A successful energy transition will seek to avoid such displacements through smart policies. Carbon capture can play an integral role in enabling a just transition for workers currently employed in the energy sector. It can also be a catalyst to new energy economies – particularly CCS with hydrogen. Decarbonised hydrogen production by steam methane reforming (SMR)/gasification coupling with CCS has been at scale in commercial practice for decades with industrial applications. Turning to policymakers: What’s next? Government support for climate investments: According to the IEA, 70% of global energy investments are expected to be driven by government decisions - and so how the energy transition will pan out depends on policymakers. Sufficient investment in CCS will not happen without strong and sustained government policy. A value on carbon: Climate policies needs to reflect the externalities created by pollution through placing a value on carbon, like the tax credits in the US or the carbon tax in Norway. A value on carbon creates a business case for investment in CCS. Policy confidence: CCS requires investment in long-lived capital assets, which will not happen without having confidence in predictable and stable policies. We may still have just enough time to save the world from the disastrous effects of climate change – but only if we enact those decarbonisation policies that will enable growth and a just transition. In a technology-neutral playing field, CCS will naturally take a central role as one of the key climate solutions.

#### NETs link turns their impact.

Fred Krupp et al. 19. Nathaniel [Keohane](https://search-proquest-com.libproxy2.usc.edu/indexinglinkhandler/sng/au/Keohane,+Nathaniel/$N?accountid=14749), and Eric Pooley. \*President of Environmental Defense Fund, a United States-based nonprofit environmental advocacy group. \*\*Vice president for international climate at the Environmental Defense Fund. He used to be in academia at Yale University and served in the White House as special assistant to President Barack Obama. \*\*\*Senior Vice President, Strategy & Communications at the Environmental Defense Fund. 4-1-2019. "Less Than Zero: Can Carbon-Removal Technologies Curb Climate Change?" Foreign Affairs. https://search-proquest-com.libproxy2.usc.edu/docview/2186099162/594BA6C689D844ABPQ/13?accountid=14749/

\*GHGs = greenhouse gases

\*NET = negative emissions technology

When it comes to generating support for climate policy, a warranted sense of alarm is only half the battle. And the other half-a shared belief that the problem is solvable-is lagging far behind. The newfound sense of urgency is at risk of being swamped by collective despair. A scant six percent of Americans, according to the Yale study, believe that the world "can and will" effectively address climate change. With carbon dioxide emissions from fossil fuels having risen by an estimated 2.7 percent in 2018 and atmospheric concentrations of carbon dioxide, which will determine the ultimate extent of warming, at their highest level in some three million years, such pessimism may seem justified-especially with a climate change denier in the White House. But it is not too late to solve the global climate crisis. A decade of extraordinary innovation has made the greening of the global economy not only feasible but also likely. The market now favors clean energy: in many U.S. states, it is cheaper to build new renewable energy plants than to run existing coal-fired power plants. By combining solar power with new, efficient batteries, Arizona and other sunny states will soon be able to provide electricity at a lower cost per megawatthour than new, efficient natural gas plants. Local, regional, and federal governments, as well as corporations, are making measurable progress on reducing carbon pollution. Since 2000, 21 countries have reduced their annual greenhouse gas emissions while growing their economies; China is expected to see emissions peak by 2025, five years earlier than it promised as part of the negotiations for the Paris climate agreement in 2015. At the UN climate talks held late last year in Poland, countries agreed on rules for how to report progress on meeting emission-reduction commitments, an important step in implementing the Paris accord. What's more, an entirely new arsenal is emerging in the fight against climate change: negative emission technologies, or nets. Nets are different from conventional approaches to climate mitigation in that they seek not to reduce the amount of greenhouse gases emitted into the atmosphere but to remove carbon dioxide that's already there. These technologies range from the old-fashioned practice of reforestation to high-tech machines that suck carbon out of the sky and store it underground. The window of opportunity to combat climate change has not closed-and with a push from policymakers, nets can keep it propped open for longer. THE HEAT IS ON How much time is left to avoid climate catastrophe? The truth is that it is impossible to answer the question with precision. Scientists know that human activity is warming the planet but still don't fully understand the sensitivity of the climate system to greenhouse gases. Nor do they fully comprehend the link between average global warming and local repercussions. So far, however, most effects of climate change have been faster and more severe than the climate models predicted. The downside risks are enormous; the most recent predictions, ever more dire. The Paris agreement aims to limit the increase in global average temperatures above preindustrial levels to well below two degrees Celsius, and ideally to no more than 1.5 degrees Celsius. Going above those levels of warming would mean more disastrous impacts. Global average temperatures have already risen by about one degree Celsius since 1880, with two-thirds of that increase occurring after 1975. An October 2018 special report by the un's Intergovernmental Panel on Climate Change, a body of leading scientists and policymakers from around the world, found that unless the world implements "rapid and far-reaching" changes to its energy and industrial systems, the earth is likely to reach temperatures of 1.5 degrees Celsius above preindustrial levels sometime between 2030 and 2052. Limiting warming to that level, the ipcc found, would require immediate and dramatic cuts in carbon dioxide: roughly a 45 percent reduction in the next dozen years. Even meeting the less ambitious target of two degrees would require deep cuts in emissions by 2030 and sustained aggressive action far beyond then. The ipcc report also warns that seemingly small global temperature increases can have enormous consequences. For example, the half-degree difference between 1.5 degrees Celsius and two degrees Celsius of total warming could consign twice as many people to water scarcity, put ten million more at risk from rising sea levels, and plunge several hundred million more people into poverty as lower yields of key crops drive hunger across much of the developing world. At two degrees of warming, nearly all of the planet's coral reefs are expected to be lost; at 1.5 degrees, ten to 30 percent could survive. The deeper message of the IPCC report is that there is no risk-free level of climate change. Targets such as 1.5 degrees Celsius or two degrees Celsius are important political markers, but they shouldn't fool anyone into thinking that nature works so precisely. Just as the risks are lower at 1.5 degrees Celsius than at two degrees Celsius, so are they lower at two degrees Celsius than at 2.5 degrees Celsius. Indeed, the latter difference would be far more destructive, since the damages mount exponentially as temperatures rise. To manage the enormous risks of climate change, global emissions of greenhouse gases need to be cut sharply, and as soon as possible. That will require transforming energy, land, transport, and industrial systems so they emit less carbon dioxide. It will also require reducing short-lived climate pollutants such as methane, which stay in the atmosphere for only a fraction of the time that carbon dioxide does but have a disproportionate effect on near-term warming. Yet even that will not be enough. To stabilize the total atmospheric concentration of carbon dioxide and other greenhouse gases [GHGs], the world will have to reach net negative emissions-that is, taking more greenhouse gases out of the atmosphere than are being pumped into it. Achieving that through emission reductions alone will be extremely difficult, since some emissions, such as of methane and nitrous oxide from agriculture, are nearly impossible to eliminate. Countering the emissions that are hardest to abate, and bring concentrations down to safer levels, requires technologies that actually remove carbon dioxide from the atmosphere. That's where nets come in-not as a substitute for aggressive efforts to reduce greenhouse gas emissions but as a complement. By deploying technology that removes existing carbon dioxide from the atmosphere, while accelerating cuts in emissions, the world can boost its chances of keeping warming below two degrees and reduce the risk of catastrophe. Scientists and activists have tended to regard these technologies as a fallback option, to be held in reserve in case other efforts fail. Many fear that jumping ahead to carbon dioxide removal will distract from the critical need to cut pollution. But the world no longer has the luxury of waiting for emission-reduction strategies to do the job alone. Far from being a Plan B, nets must be a critical part of Plan A. What's more, embracing nets sooner rather than later makes economic sense. Because the marginal costs of emission reductions rise as more emissions are cut, it will be cheaper to deploy nets at the same time as emission-reduction technologies rather than waiting to exhaust those options first. The wider the solution set, the lower the costs. And the lower the costs, the easier it is to raise ambitions and garner the necessary political support. THE FUTURE IS NOW Even though removing carbon dioxide from the atmosphere may sound like the stuff of science fiction, there are already nets that could be deployed at scale today, according to a seminal report released by the National Academies of Sciences, Engineering, and Medicine in October 2018. One category involves taking advantage of carbon sinks-the earth's forests and agricultural soils, which have soaked up more carbon dioxide since the Industrial Revolution than has been released from burning petroleum. To date, the growth of carbon sinks has been inadvertent: in the United States, for example, as agriculture shifted from the rocky soils of the Northeast to the fertile Midwest, forests reclaimed abandoned farmland, breathing in carbon dioxide in the process. But this natural process can be improved through better forest management-letting trees grow longer before they are harvested and helping degraded forests grow back more quickly. The large-scale planting of trees in suitable locations around the world could increase carbon sinks further, a process that must go hand in hand with efforts to curb tropical deforestation and thereby continue to contain the vast amounts of carbon already stored in the earth's rainforests. Farmland provides additional potential for negative emissions. Around the world, conventional agricultural practices have reduced the amount of carbon in soils, decreasing their fertility in the process. Smarter approaches can reverse the process. Small and large landholders alike could add agricultural waste to soil, maximize the time that the soil is covered by living plants or mulch, and reduce tilling, which releases carbon dioxide. All these steps would decrease the amount of carbon that is lost from soil and increase the amount of carbon that is stored in it. The most technologically sophisticated net available in the near term is known as "bioenergy with carbon capture and storage," or BECCS. It is also the riskiest. Broadly defined, beccs involves burning or fermenting biomass, such as trees or crops, to generate electricity or make liquid fuel; capturing the carbon dioxide produced in the process; and sequestering it underground. It is considered a negative emission technology, and not a zero emission technology, because growing the biomass used in the process removes carbon from the atmosphere. What makes BECCS so exciting is its potential to remove significantly more carbon from the atmosphere than other approaches do. But it also brings challenges. For one, it is expensive: electricity generated from beccs could cost twice as much as that generated with natural gas, because biomass is an inefficient fuel source and capturing and sequestering carbon dioxide is costly. The technology would also require careful monitoring to ensure that the carbon dioxide pumped underground stays there and clear rules for legal liability in the event of leaks. But the fact that private companies have been successfully injecting carbon dioxide into depleted oil and gas reservoirs for decades offers good evidence that permanent storage is possible on a large scale. More worrying are the additional climate risks that BECCS poses. If BECCS drives demand for biomass and more of the carbon that is stored in the forest ecosystem is released as a result, it could end up raising the level of carbon in the atmosphere rather than reducing it. Another concern is competition for land: converting farms or forests to grow energy crops, something that the large-scale use of BEccs might require, could drive up the cost of food, reduce agricultural production, and threaten scarce habitats. These problems could be mitigated by using only biomass waste, such as residues from logging and agriculture, but that would reduce the potential scale. Although BEccs deserves consideration as part of the arsenal, these risks mean that its contribution will likely end up being smaller than some proponents claim. Taking all these land-based nets together, and factoring in the considerable economic, practical, and behavioral hurdles to bringing them to scale, the National Academies report concludes that by midcentury, nets could remove as much as five billion tons of carbon dioxide from the atmosphere annually. Given the significant risks involved, that estimate is probably too bullish. Even if it were not, that's still only half of the ten billion tons of carbon dioxide that will likely need to be removed each year to zero out the remaining greenhouse gas emissions, even with aggressive cuts. CLOSING THE GAP Removing from the atmosphere the balance of the carbon dioxide necessary will require perfecting technologies currently in development. Two deserve particular mention; both are full of promise, although neither is ready for widespread use. The first is called "direct air capture"- essentially, sucking carbon from the sky. The technology is already being tested in Canada, Iceland, Italy, and Switzerland at pilot plants where massive arrays of fans direct a stream of air toward a special substance that binds with the passing carbon dioxide. The substance is then either heated or forced into a vacuum to release the carbon dioxide, which is compressed and either stored or used as feedstocks for chemicals, fuels, or cement. These technologies are real-albeit prohibitively expensive in their current form. As a recent study led by David Sandalow of Columbia University's Center on Global Energy Policy concludes, taking them to scale means solving a variety of technological challenges to bring down the costs. Above all, these processes are highly energy intensive, so scaling them would require enormous amounts of low-carbon electricity. (A direct-air-capture facility powered by coal-fired electricity, for example, would generate more new carbon dioxide than it would capture.) These obstacles are serious, but the surprising progress of the past decade suggests that they can be overcome in the next one. The second technology, enhanced carbon mineralization, is even further from being realized, but it is full of even more possibility. Geologists have long known that when rock from the earth's mantle (the layer of the earth between its crust and its core) is exposed to the air, it binds with carbon dioxide to form carbon-containing minerals. The massive tectonic collisions that formed the Appalachian Mountains around 460 million years ago, for example, exposed subsurface rock to weathering that resulted in the absorption of substantial amounts of carbon dioxide from the atmosphere. That took tens of millions of years; enhanced carbon mineralization seeks to fast-forward the process. Scientists are exploring two ways to do this. In one approach, rocks would be brought to the surface to bind with carbon from the air. Such natural weathering already occurs in mine tailings, the waste left over from certain mining operations. But mimicking this process on a large scale-by grinding up large quantities of rock containing reactive minerals and bringing it to the earth's surface-would be highly energy intensive and thus costly, roughly on par with direct air capture. Another potential approach is pumping the carbon dioxide underground to meet the rock. As the National Academies report explains, carbon-dioxide-rich fluids injected into basalt or peridotite formations (two kinds of igneous rock that make up much of the earth's mantle) react with the rock, converting the dissolved carbon dioxide into solid carbon-containing minerals. Pilot projects in Iceland and the United States have demonstrated that this is possible. There is also evidence for how this could work in the natural world. Peridotite usually lies deep inside the earth, but some rock formations around the globe contain pockets of it on the surface. For example, scientists are studying how the surface-level peridotite in Oman's rock formations reacts with the air and absorbs large amounts of carbon. In theory, this approach offers nearly unlimited scale, because suitable rock formations are widespread and readily accessible. It would also be cheap, because it takes advantage of chemical potential energy in the rock instead of costly energy sources. And since the carbon dioxide is converted to solid rock, the effect is permanent, and it carries few of the side effects that other nets could bring. GETTING TO LESS These technologies do not come cheap. The National Academy of Sciences recommends as much as $1 billion annually in U.S. government funding for research on nets. And indeed, such funding should be an urgent priority. But to make these technologies economically viable and scale them rapidly, policymakers will also have to tap into a much more powerful force: the profit motive. Putting a price on carbon emissions creates an economic incentive for entrepreneurs to find cheaper, faster ways to cut pollution. Valuing negative emissions-for example, through an emission-trading system that awards credits for carbon removal or a carbon tax that provides rebates for them-would create an incentive for them to join the hunt for nets. Forty-five countries, along with ten U.S. states, have put in place some mechanism to price carbon. But only a handful of them offer rewards for converting land into forest, managing existing forests better, or increasing the amount of carbon stored in agricultural soils, and none offers incentives for other nets. What's needed is a carbon pricing system that not only charges those who emit carbon but also pays those who remove it. Such a system would provide new revenue streams for landowners who restored forest cover to their land and for farmers and ranchers who increased the amount of carbon stored in their soils. It would also reward the inventors and entrepreneurs who developed new, better technologies to capture carbon from the air and the investors and businesses that took them to scale. Without these incentives, those players will stay on the sidelines. By spurring innovation in lower-cost nets, incentives would also ease the way politically for an ambitious pollution limit-which, ultimately, is necessary for ensuring that the world meets it climate goals. Simply put, humanity's best hope is to promise that the next crop of billionaires will be those who figure out low-cost ways to remove carbon from the sky. The biggest hurdle for such incentives is the lack of a global market for carbon credits. Hope on that front, however, is emerging from an unlikely place: aviation. Currently responsible for roughly two percent of global greenhouse gases, aviation's emissions are expected to triple or quadruple by midcentury in the absence of effective policies to limit them. But in 2016, faced with the prospect that the eu would start capping the emissions of flights landing in and taking off from member states, the un body that governs worldwide air travel, the International Civil Aviation Organization, agreed to cap emissions from international flights at 2020 levels. The airline industry supported the agreement, hoping to avoid the messy regulatory patchwork that might result if the eu went ahead and states beyond the eu followed suit with their own approaches. The resulting program, called the Carbon Offsetting and Reduction Scheme for International Aviation (corsia), requires all airlines to start reporting emissions this year, and it will begin enforcing a cap in 2021. Once in full swing, at least 100 countries are expected to participate, covering at least three-quarters of the forecast increase in international aviation emissions. Airlines flying between participating countries will have two ways to comply: they can lower their emissions (for example, by burning less fuel or switching to alternative fuels), or they can buy emission-reduction credits from companies. Because the technologies for reducing airline emissions at scale are still a long way off, the industry will mostly choose the second option, relying on carbon credits from reductions in other sectors. It is estimated that over the first 15 years of corsia, demand for these credits will reach between 2.5 billion and 3.0 billion tons-roughly equal to the annual greenhouse gas emissions from the U.S. power and manufacturing sectors. With this new option to sell emission-reduction credits to airlines, there is a good possibility that a pot of gold will await companies that cut or offset their carbon emissions. In short, corsia could catalyze a global carbon market that drives investment in low-carbon fuels and technologies-including nets. To realize its promise, corsia must be implemented properly, and there are powerful forces working to see that it is not. Some countries, including ones negotiating on behalf of their state-owned companies, are trying to rig the system by allowing credits from projects that do not produce legitimate carbon reductions, such as Brazil's effort to allow the sale of credits from huge hydroelectric dams in the Amazon that have already been built and paid for (and thus do not represent new reductions). Allowing such credits into the system could crowd out potential rewards for genuine reductions. But there are also powerful, sometimes unexpected allies who stand to gain from a global carbon market that works. For example, some airlines are motivated to act out of a fear that millennials, concerned about their carbon footprint, may eventually begin to shun air travel. The new regulations, by creating demand for emission reductions and spurring investment in nets to produce jet fuel, could be the industry's best hope of protecting its reputation-and a critical step toward a broader global carbon market that moves nets from promising pilot projects to a gamechanging reality. Skeptics say that nets are too speculative and a possibility only, perhaps, in the distant future. It is true that these innovations are not fully understood and that not all of them will pan out. But no group of scholars and practitioners, no matter how expert, can determine exactly which technologies should be deployed and when. It is impossible to predict what future innovations will look like, but that shouldn't stop the world from pursuing them, especially when the threat is so grave. The fact remains that many nets are ready to be deployed at scale today, and they might make the difference between limiting warming to two degrees and failing to do so. Ultimately, climate change will be stopped by creating economic incentives that unleash the innovation of the private sector-not by waiting for the perfect technology to arrive ready-made, maybe when it's already too late. No one is saying that achieving all of this will be easy, but the road to climate stability has never been that. Hard does not mean impossible, however, and the transformative power of human ingenuity offers an endless source of hope.

#### China’s strategic calculus is driven by structural concerns---proves our thesis---BUT voids the explanatory power of their empirics.

Ashley J. Tellis 8. Senior Associate at the Carnegie Endowment for International Peace. 2008. “China's Military Space Strategy: An Exchange.” Response by Tellis, Survival, Volume 50, 2008 - Issue 1.

I found Eric Hagt's critique of my article more difficult to address than Krepon's because it is based on what appears to be a misunderstanding, at least in the first instance. Using my prognosis of a Sino-American rivalry over the long term as the ‘hermeneutic key’, Hagt infers that my analysis of China's military space programme is driven by ‘the core assumption … that China is seeking to construct a “Sinocentric order in Asia and perhaps globally"’. From this assumption, he enquires: ‘How does Tellis know Beijing is committed to such an expansive military strategy or will challenge US military dominance?’ I would respectfully suggest that both these questions, which form the fundamental basis of Hagt's critique, and Bao Shixiu's for that matter, are actually quite peripheral to my argument. I do happen to believe that Sino-American security competition at the core of the global system is likely to ensue over the long term, but only if China's acquisition of comprehensive national power is successful enough to make it a reasonable ‘peer competitor’ of the United States. Under such circumstances, which will not confront Washington for some time, the political order, at least in the Asia-Pacific, would inevitably, even if only gradually, become Sinocentric, and Sinic influence could - not would - extend to the entire globe over time, depending on what happened to the relative power of the United States in the interim. This expostulation does not require China to consciously construct a Sinocentric order in Asia or elsewhere: that will occur simply as a result of the uninterrupted accretion in Chinese national power relative to others. If such an outcome materialises, however, it would be shocking if China, in contrast to every other great power in recorded history and its own past behaviour during periods of pre-eminence, chose not to utilise its new-found power to advance its material interests, cement its status and exercise its influence, as a legitimate right. Bao asserts that whatever global or Chinese history may indicate, the emerging Chinese superpower will never behave in this time-honoured fashion because, as he puts it, ‘history is history, but the situation is always changing’. Further, he declares that we must believe this to be the case because ‘China's leaders have asserted repeatedly that China is not [a] superpower, nor will it ever become one’. While Beijing's interest in maintaining a non-threatening profile in the current international order is eminently understandable (it is, after all, one precondition for the successful Chinese accumulation of national power), the assertion that China will never ‘seek hegemony or world dominance’ is less a function of Beijing's intentions now and more a function of how its own material capabilities grow vis-à-vis those of others over time. It is difficult to offer any precise predictions in this regard, except that if China does become a true great power in the future, odds are that it will behave like other great powers have in the past. And, further, it will be led along this path despite its initial inclinations because, as social scientists would readily understand, the competitive structure of the international system would compel China to behave like any ‘ordinary’ great power even if it had originally sought to conduct itself as an ‘exceptional’ one. The history of the United States itself is a fascinating testament to this ‘tyranny of the structure’. The future international system is likely to be more complex in comparison to that which has gone before. The presence of nuclear weapons, the realities of globalisation and the cross-cutting cleavages of ethnicity and ideology will all intersect in complex fashion to simultaneously constrain and liberate China's choices. But none of these realities will alter the one fundamental prediction that should be of relevance to both Hagt and Bao: all great powers, China included, will constantly strive to increase their security, power and influence, by contestation when necessary, so long as the international system remains ‘anarchic’ in the sense understood since Thucydides. This expectation, more than any other, is what drives my judgement that US-China relations are likely to be competitive over the long term, if both states come to represent a new bipolar ordering in international politics. (Of course, bilateral relations could become conflictual for many lesser reasons as well and in considerable advance of the onset of bipolarity, but such competition would be attributed to the warp and woof of normal international politics and not to the challenges imposed by what John Gerard Ruggie once called its ‘deep structure’.4 4 John Gerard Ruggie, ‘Continuity and Transformation in the World Polity: Toward a Neorealist Synthesis’, in Robert O. Keohane (ed.), Neorealism and its Critics (New York: Columbia University Press, 1986), p. 135. View all notes )

#### China’s a revisionist power hell-bent on taking over the world

Brands, 20

(Hal, the Henry A. Kissinger Distinguished Professor of Global Affairs at the Johns Hopkins University School of Advanced International Studies (SAIS) and a Resident Scholar at the American Enterprise Institute "What Does China Really Want? To Dominate the World," 5/20/20 <https://www.bloomberg.com/opinion/articles/2020-05-20/xi-jinping-makes-clear-that-china-s-goal-is-to-dominate-the-world> NL)

Can we pay the Chinese Communist Party the compliment of acknowledging that it means what it says and knows what it wants? That may be the key to understanding Beijing’s strategic ambitions in the coming decades. A long-standing trope in the U.S. [debate](https://warontherocks.com/2018/12/wotr-podcast-full-steam-ahead-naval-competition-with-china/) on [that](https://warontherocks.com/2019/01/the-party-congress-test-a-minimum-standard-for-analyzing-beijings-intentions/) [subject](https://www.brookings.edu/wp-content/uploads/2018/10/fp_20181018_us_china_transcript.pdf) is that China itself doesn’t know what it seeks to achieve, that its leaders haven’t yet worked out how far Beijing’s influence should reach. Yet there is a growing body of evidence, assembled and interpreted by talented China experts, that the Chinese government is indeed aiming for global power and perhaps global primacy over the next generation — that it seeks to upend the American-led international system and create at least a competing, quasi-world order of its own. It doesn’t take unparalleled powers of deduction to reach this conclusion. Top Chinese officials and members of the country’s foreign policy community are becoming increasingly explicit in saying so themselves. President Xi Jinping more than hinted at this goal in his landmark address to the 19th Party Congress in October 2017. That speech [represents](https://www.uscc.gov/sites/default/files/testimonies/SFR%20for%20USCC%20TobinD%2020200313.pdf) one of the most authoritative statements of the party’s policy and aims; it reflects Xi’s [understanding](https://twitter.com/PLMattis/status/1259592233726205953) of what China has accomplished under Communist rule and how it must advance in the future. Xi [declared](http://www.xinhuanet.com/english/download/Xi_Jinping's_report_at_19th_CPC_National_Congress.pdf) that China “has stood up, grown rich, and is becoming strong,” and that it was now “blazing a new trail for other developing countries” and offering “Chinese wisdom and a Chinese approach to solving the problems facing mankind.” By 2049, Xi promised, China would “become a global leader in terms of composite national strength and international influence” and would build a “stable international order” in which China’s “national rejuvenation” could be fully achieved. This was the statement of a leader who sees his country not just participating in global affairs but setting the terms, and it testifies to two core themes in China’s foreign policy discourse. The first is a deeply skeptical view of the existing international system. Chinese leaders recognize that the global trade regime has been indispensable to the country’s economic and military rise. Yet when they look at the key features of the world Washington and its allies have made, they see mostly [threats](https://tnsr.org/2018/11/xis-vision-for-transforming-global-governance-a-strategic-challenge-for-washington-and-its-allies/). In their view, American alliances do not preserve peace and stability; they stunt China’s potential and prevent Asian nations from giving Beijing its due. Seen through that lens, promoting democracy and human rights is neither moral nor benign, but propaganda supporting a dangerous doctrine that threatens to delegitimize the Communist government and energize its domestic enemies. U.S.-led international institutions appear as tools for imposing America’s will on weaker states. The Communist Party recognizes that the liberal international order has brought benefits, [writes](https://www.nbr.org/wp-content/uploads/pdfs/publications/sr83_chinasvision_jan2020.pdf) Nadege Rolland, a senior fellow at the National Bureau of Asian Research, but “the party abhors and dreads” the principles on which it is based. The second theme is that the international order must change — not a little, but a lot — for China to become fully prosperous and secure. Chinese leaders have, understandably, been somewhat opaque in describing the world they want, but the outlines are becoming easier to discern. If one studies the statements of Xi and other top officials, China expert Liza Tobin [concludes](https://tnsr.org/2018/11/xis-vision-for-transforming-global-governance-a-strategic-challenge-for-washington-and-its-allies/), what emerges is a vision in which “a global network of partnerships centered on China would replace the U.S. system of treaty alliances” and the world would view Chinese authoritarianism as preferable to Western democracy. Based on a similar analysis, Rolland [agrees](https://www.nbr.org/wp-content/uploads/pdfs/publications/sr83_chinasvision_jan2020.pdf) that China has “a yearning for partial hegemony,” a loose dominance over large swaths of the global south. When it comes to global governance, still other [examinations](https://www.tabletmag.com/sections/news/articles/china-plans-global-order) [show](https://www.americanprogress.org/issues/security/reports/2019/02/28/466768/mapping-chinas-global-governance-ambitions/), Beijing wants a system in which international institutions buttress rather than batter repressive regimes. Meanwhile, Chinese strategists and academics are talking openly about building a “new China-centric global economic order.” There is little indication, in any of this, that Beijing’s strategic horizon is limited to the Western Pacific or even Asia. Xi’s [invocation](http://www.xinhuanet.com/english/2019-10/03/c_138445509.htm) of a “community with a shared future for humanity” [indicates](https://warontherocks.com/2019/01/the-party-congress-test-a-minimum-standard-for-analyzing-beijings-intentions/) a [global](https://tnsr.org/2018/11/xis-vision-for-transforming-global-governance-a-strategic-challenge-for-washington-and-its-allies/) tableau for Chinese influence. One hardly has to read between the lines to understand that this agenda will require fundamentally resetting the current geopolitical balance. As Xi [remarked](https://www.uscc.gov/sites/default/files/testimonies/SFR%20for%20USCC%20TobinD%2020200313.pdf) several years ago, China must work resolutely toward “a future where we will win the initiative and have the dominant position.” Of course, there’s not need to take literally everything national leaders say, or even everything that makes it into official speeches. In Beijing’s case, however, Chinese leaders are actually saying less than what the country is doing. Whether it is the naval shipbuilding program that is churning out vessels at astonishing rate; the drive to [control](https://www.bloomberg.com/opinion/articles/2020-03-31/china-s-influence-operation-goes-beyond-who-taiwan-and-covid-19) existing international organizations and build new ones; the projection of military power in the [Arctic](https://www.cambridge.org/core/books/china-as-a-polar-great-power/22493FFC041E6739DAED329CCB71F688#fndtn-information), the Indian Ocean and points beyond; the quest to [dominate](https://www.pbs.org/wgbh/frontline/article/made-in-china-2025-the-industrial-plan-that-china-doesnt-want-anyone-talking-about/) the world’s high-tech industries; the ever-more [systematic](https://halbrands.org/wp-content/uploads/2018/09/60-5-07-Brands.pdf) efforts to support authoritarian regimes and weaken democratic institutions; or the Belt and Road Initiative that [encompasses](https://tnsr.org/2019/07/unlocking-the-gates-of-eurasia-chinas-belt-and-road-initiative-and-its-implications-for-u-s-grand-strategy/) multiple continents, China is hardly acting like a country that lacks a grand geopolitical design. As with so many aspects of the U.S.-China competition, there is a Cold War parallel. During the 1970s, some leading American Sovietologists insisted that Moscow was becoming a satisfied, status quo power. Yet that claim required ignoring what Soviet leaders [said](https://www.google.com/books/edition/What_Good_Is_Grand_Strategy/nGqoAgAAQBAJ?hl=en&gbpv=1&bsq=%22we%20make%20no%20secret%22) about detente and peaceful coexistence — that it was a way of ensuring the triumph of socialism without war — as well as their efforts to build military superiority and positions of strength in the Third World. The warning signs were evident then, as they are today. China probably doesn’t have a step-by-step checklist for achieving global primacy, any more than the Soviet Union did in the 1970s. Chinese leaders aren’t insensitive to costs and obstacles: Xi may ritualistically restate the importance of unifying the Chinese nation, but that [doesn’t mean](https://twitter.com/resplinodell/status/1259883799254634498) he’s hell-bent on war over Taiwan. Beijing may not even have decided which of its two paths to global influence is preferable: Establishing dominance in the Western Pacific and then expanding outward from there, or outflanking the U.S. position in the region by building up economic and political power around the world. Finally, China may ultimately fail to accomplish any of this. Perhaps the coronavirus will so weaken the U.S. and the liberal order that China’s ascent will be accelerated. Or perhaps China will run into so many internal problems, and so much external resistance, that its drive will stall. Yet we ought to recognize that the debate about what China wants is growing stale, because China’s leaders and behavior have increasingly answered that question. When a proud and powerful challenger starts to advertise its global ambitions, Americans should probably err on the side of taking those ambitious seriously.

#### Extinction outweighs – any risk is a reason to err aff.

Seth D. Baum and Anthony M. Barrett 18. Global Catastrophic Risk Institute. 2018. “Global Catastrophes: The Most Extreme Risks.” Risk in Extreme Environments: Preparing, Avoiding, Mitigating, and Managing, edited by Vicki Bier, Routledge, pp. 174–184.

2. What Is GCR And Why Is It Important? Taken literally, a global catastrophe can be any event that is in some way catastrophic across the globe. This suggests a rather low threshold for what counts as a global catastrophe. An event causing just one death on each continent (say, from a jet-setting assassin) could rate as a global catastrophe, because surely these deaths would be catastrophic for the deceased and their loved ones. However, in common usage, a global catastrophe would be catastrophic for a significant portion of the globe. Minimum thresholds have variously been set around ten thousand to ten million deaths or $10 billion to $10 trillion in damages (Bostrom and Ćirković 2008), or death of one quarter of the human population (Atkinson 1999; Hempsell 2004). Others have emphasized catastrophes that cause long-term declines in the trajectory of human civilization (Beckstead 2013), that human civilization does not recover from (Maher and Baum 2013), that drastically reduce humanity’s potential for future achievements (Bostrom 2002, using the term “existential risk”), or that result in human extinction (Matheny 2007; Posner 2004). A common theme across all these treatments of GCR is that some catastrophes are vastly more important than others. Carl Sagan was perhaps the first to recognize this, in his commentary on nuclear winter (Sagan 1983). Without nuclear winter, a global nuclear war might kill several hundred million people. This is obviously a major catastrophe, but humanity would presumably carry on. However, with nuclear winter, per Sagan, humanity could go extinct. The loss would be not just an additional four billion or so deaths, but the loss of all future generations. To paraphrase Sagan, the loss would be billions and billions of lives, or even more. Sagan estimated 500 trillion lives, assuming humanity would continue for ten million more years, which he cited as typical for a successful species. Sagan’s 500 trillion number may even be an underestimate. The analysis here takes an adventurous turn, hinging on the evolution of the human species and the long-term fate of the universe. On these long time scales, the descendants of contemporary humans may no longer be recognizably “human”. The issue then is whether the descendants are still worth caring about, whatever they are. If they are, then it begs the question of how many of them there will be. Barring major global catastrophe, Earth will remain habitable for about one billion more years 2 until the Sun gets too warm and large. The rest of the Solar System, Milky Way galaxy, universe, and (if it exists) the multiverse will remain habitable for a lot longer than that (Adams and Laughlin 1997), should our descendants gain the capacity to migrate there. An open question in astronomy is whether it is possible for the descendants of humanity to continue living for an infinite length of time or instead merely an astronomically large but finite length of time (see e.g. Ćirković 2002; Kaku 2005). Either way, the stakes with global catastrophes could be much larger than the loss of 500 trillion lives. Debates about the infinite vs. the merely astronomical are of theoretical interest (Ng 1991; Bossert et al. 2007), but they have limited practical significance. This can be seen when evaluating GCRs from a standard risk-equals-probability-times-magnitude framework. Using Sagan’s 500 trillion lives estimate, it follows that reducing the probability of global catastrophe by a mere one-in-500-trillion chance is of the same significance as saving one human life. Phrased differently, society should try 500 trillion times harder to prevent a global catastrophe than it should to save a person’s life. Or, preventing one million deaths is equivalent to a one-in500-million reduction in the probability of global catastrophe. This suggests society should make extremely large investment in GCR reduction, at the expense of virtually all other objectives. Judge and legal scholar Richard Posner made a similar point in monetary terms (Posner 2004). Posner used $50,000 as the value of a statistical human life (VSL) and 12 billion humans as the total loss of life (double the 2004 world population); he describes both figures as significant underestimates. Multiplying them gives $600 trillion as an underestimate of the value of preventing global catastrophe. For comparison, the United States government typically uses a VSL of around one to ten million dollars (Robinson 2007). Multiplying a $10 million VSL with 500 trillion lives gives $5x1021 as the value of preventing global catastrophe. But even using “just" $600 trillion, society should be willing to spend at least that much to prevent a global catastrophe, which converts to being willing to spend at least $1 million for a one-in-500-million reduction in the probability of global catastrophe. Thus while reasonable disagreement exists on how large of a VSL to use and how much to count future generations, even low-end positions suggest vast resource allocations should be redirected to reducing GCR. This conclusion is only strengthened when considering the astronomical size of the stakes, but the same point holds either way. The bottom line is that, as long as something along the lines of the standard riskequals-probability-times-magnitude framework is being used, then even tiny GCR reductions merit significant effort. This point holds especially strongly for risks of catastrophes that would cause permanent harm to global human civilization. The discussion thus far has assumed that all human lives are valued equally. This assumption is not universally held. People often value some people more than others, favoring themselves, their family and friends, their compatriots, their generation, or others whom they identify with. Great debates rage on across moral philosophy, economics, and other fields about how much people should value others who are distant in space, time, or social relation, as well as the unborn members of future generations. This debate is crucial for all valuations of risk, including GCR. Indeed, if each of us only cares about our immediate selves, then global catastrophes may not be especially important, and we probably have better things to do with our time than worry about them. While everyone has the right to their own views and feelings, we find that the strongest arguments are for the widely held position that all human lives should be valued equally. This position is succinctly stated in the United States Declaration of Independence, updated in the 1848 Declaration of Sentiments: “We hold these truths to be self-evident: that all men and 3 women are created equal”. Philosophers speak of an agent-neutral, objective “view from nowhere” (Nagel 1986) or a “veil of ignorance” (Rawls 1971) in which each person considers what is best for society irrespective of which member of society they happen to be. Such a perspective suggests valuing everyone equally, regardless of who they are or where or when they live. This in turn suggests a very high value for reducing GCR, or a high degree of priority for GCR reduction efforts.

#### Economic collapse causes global war.

Sundaram 19—(Sundaram - former economics professor, was United Nations Assistant Secretary-General for Economic Development, and received the Wassily Leontief Prize for Advancing the Frontiers of Economic Thought; Popov - former senior economics researcher in the Soviet Union, Russia and the United Nations Secretariat, is now Research Director at the Dialogue of Civilizations Research Institute in Berlin). Jomo Kwame Sundaram and Vladimir Popov. “Economic Crisis Can Trigger World War”, Inter Press Service, February, <http://www.ipsnews.net/2019/02/economic-crisis-can-trigger-world-war/>.

Economic recovery efforts since the 2008-2009 global financial crisis have mainly depended on unconventional monetary policies. As fears rise of yet another international financial crisis, there are growing concerns about the increased possibility of large-scale military conflict. More worryingly, in the current political landscape, prolonged economic crisis, combined with rising economic inequality, chauvinistic ethno-populism as well as aggressive jingoist rhetoric, including threats, could easily spin out of control and ‘morph’ into military conflict, and worse, world war. Crisis responses limited The 2008-2009 global financial crisis almost ‘bankrupted’ governments and caused systemic collapse. Policymakers managed to pull the world economy from the brink, but soon switched from counter-cyclical fiscal efforts to unconventional monetary measures, primarily ‘quantitative easing’ and very low, if not negative real interest rates. But while these monetary interventions averted realization of the worst fears at the time by turning the US economy around, they did little to address underlying economic weaknesses, largely due to the ascendance of finance in recent decades at the expense of the real economy. Since then, despite promising to do so, policymakers have not seriously pursued, let alone achieved, such needed reforms. Instead, ostensible structural reformers have taken advantage of the crisis to pursue largely irrelevant efforts to further ‘casualize’ labour markets. This lack of structural reform has meant that the unprecedented liquidity central banks injected into economies has not been well allocated to stimulate resurgence of the real economy. From bust to bubble Instead, easy credit raised asset prices to levels even higher than those prevailing before 2008. US house prices are now 8% more than at the peak of the property bubble in 2006, while its price-to-earnings ratio in late 2018 was even higher than in 2008 and in 1929, when the Wall Street Crash precipitated the Great Depression. As monetary tightening checks asset price bubbles, another economic crisis — possibly more severe than the last, as the economy has become less responsive to such blunt monetary interventions — is considered likely. A decade of such unconventional monetary policies, with very low interest rates, has greatly depleted their ability to revive the economy. The implications beyond the economy of such developments and policy responses are already being seen. Prolonged economic distress has worsened public antipathy towards the culturally alien — not only abroad, but also within. Thus, another round of economic stress is deemed likely to foment unrest, conflict, even war as it is blamed on the foreign. International trade shrank by two-thirds within half a decade after the US passed the Smoot-Hawley Tariff Act in 1930, at the start of the Great Depression, ostensibly to protect American workers and farmers from foreign competition! Liberalization’s discontents Rising economic insecurity, inequalities and deprivation are expected to strengthen ethno-populist and jingoistic nationalist sentiments, and increase social tensions and turmoil, especially among the growing precariat and others who feel vulnerable or threatened. Thus, ethno-populist inspired chauvinistic nationalism may exacerbate tensions, leading to conflicts and tensions among countries, as in the 1930s. Opportunistic leaders have been blaming such misfortunes on outsiders and may seek to reverse policies associated with the perceived causes, such as ‘globalist’ economic liberalization. Policies which successfully check such problems may reduce social tensions, as well as the likelihood of social turmoil and conflict, including among countries. However, these may also inadvertently exacerbate problems. The recent spread of anti-globalization sentiment appears correlated to slow, if not negative per capita income growth and increased economic inequality. To be sure, globalization and liberalization are statistically associated with growing economic inequality and rising ethno-populism. Declining real incomes and growing economic insecurity have apparently strengthened ethno-populism and nationalistic chauvinism, threatening economic liberalization itself, both within and among countries. Insecurity, populism, conflict Thomas Piketty has argued that a sudden increase in income inequality is often followed by a great crisis. Although causality is difficult to prove, with wealth and income inequality now at historical highs, this should give cause for concern. Of course, other factors also contribute to or exacerbate civil and international tensions, with some due to policies intended for other purposes. Nevertheless, even if unintended, such developments could inadvertently catalyse future crises and conflicts. Publics often have good reason to be restless, if not angry, but the emotional appeals of ethno-populism and jingoistic nationalism are leading to chauvinistic policy measures which only make things worse. At the international level, despite the world’s unprecedented and still growing interconnectedness, multilateralism is increasingly being eschewed as the US increasingly resorts to unilateral, sovereigntist policies without bothering to even build coalitions with its usual allies. Avoiding Thucydides’ iceberg Thus, protracted economic distress, economic conflicts or another financial crisis could lead to military confrontation by the protagonists, even if unintended. Less than a decade after the Great Depression started, the Second World War had begun as the Axis powers challenged the earlier entrenched colonial powers. They patently ignored Thucydides’ warning, in chronicling the Peloponnesian wars over two millennia before, when the rise of Athens threatened the established dominance of Sparta! Anticipating and addressing such possibilities may well serve to help avoid otherwise imminent disasters by undertaking pre-emptive collective action, as difficult as that may be. The international community has no excuse for being like the owners and captain of the Titanic, conceitedly convinced that no iceberg could possibly sink the great ship.

#### Shreds MAD.

Tonnesson 15—(research professor at Peace Research Institute Oslo, leader of East Asia Peace program at Uppsala University). Stein Tonnesson. 2015. “Deterrence, interdependence and Sino–US peace,” *International Area Studies Review*, Vol. 18, No. 3, 2015.

Several recent works on China and Sino–US relations have made substantial contributions to the current understanding of how and under what circumstances a combination of nuclear deterrence and economic interdependence may reduce the risk of war between major powers. At least four conclusions can be drawn from the review above: first, those who say that interdependence may both inhibit and drive conflict are right. Interdependence raises the cost of conflict for all sides but asymmetrical or unbalanced dependencies and negative trade expectations may generate tensions leading to trade wars among inter-dependent states that in turn increase the risk of military conflict (Copeland, 2015: 1, 14, 437; Roach, 2014). The risk may increase if one of the interdependent countries is governed by an inward-looking socio-economic coalition (Solingen, 2015); second, the risk of war between China and the US should not just be analysed bilaterally but include their allies and partners. Third party countries could drag China or the US into confrontation; third, in this context it is of some comfort that the three main economic powers in Northeast Asia (China, Japan and South Korea) are all deeply integrated economically through production networks within a global system of trade and finance (Ravenhill, 2014; Yoshimatsu, 2014: 576); and fourth, decisions for war and peace are taken by very few people, who act on the basis of their future expectations. International relations theory must be supplemented by foreign policy analysis in order to assess the value attributed by national decision-makers to economic development and their assessments of risks and opportunities. If leaders on either side of the Atlantic begin to seriously fear or anticipate their own nation’s decline then they may blame this on external dependence, appeal to anti-foreign sentiments, contemplate the use of force to gain respect or credibility, adopt protectionist policies, and ultimately refuse to be deterred by either nuclear arms or prospects of socioeconomic calamities. Such a dangerous shift could happen abruptly, i.e. under the instigation of actions by a third party – or against a third party. Yet as long as there is both nuclear deterrence and interdependence, the tensions in East Asia are unlikely to escalate to war. As Chan (2013) says, all states in the region are aware that they cannot count on support from either China or the US if they make provocative moves. The greatest risk is not that a territorial dispute leads to war under present circumstances but that changes in the world economy alter those circumstances in ways that render inter-state peace more precarious. If China and the US fail to rebalance their financial and trading relations (Roach, 2014) then a trade war could result, interrupting transnational production networks, provoking social distress, and exacerbating nationalist emotions. This could have unforeseen consequences in the field of security, with nuclear deterrence remaining the only factor to protect the world from Armageddon, and unreliably so. Deterrence could lose its credibility: one of the two great powers might gamble that the other yield in a cyber-war or conventional limited war, or third party countries might engage in conflict with each other, with a view to obliging Washington or Beijing to intervene.

#### Extinction—nuclear winter, ozone erosion, tech development, and environmental collapse.

PND 16—(internally citing Zbigniew Brzezinski, Council of Foreign Relations and former national security adviser to President Carter, Toon and Robock’s 2012 study on nuclear winter in the Bulletin of Atomic Scientists, Gareth Evans’ International Commission on Nuclear Non-proliferation and Disarmament Report, Congressional EMP studies, studies on nuclear winter by Seth Baum of the Global Catastrophic Risk Institute and Martin Hellman of Stanford University, and U.S. and Russian former Defense Secretaries and former heads of nuclear missile forces). People for Nuclear Disarmament. Brief submitted to the United Nations General Assembly, Open-Ended Working Group on nuclear risks. A/AC.286/NGO/13. 05-03-2016. <http://www.reachingcriticalwill.org/images/documents/Disarmament-fora/OEWG/2016/Documents/NGO13.pdf>

Consequences human survival 12. Even if the 'other' side does NOT launch in response the smoke from 'their' burning cities (incinerated by 'us') will still make 'our' country (and the rest of the world) uninhabitable, potentially inducing global famine lasting up to decades. Toon and Robock note in ‘Self Assured Destruction’, in the Bulletin of Atomic Scientists 68/5, 2012, that: 13. “A nuclear war between Russia and the United States, even after the arsenal reductions planned under New START, could produce a nuclear winter. Hence, an attack by either side could be suicidal, resulting in self assured destruction. Even a 'small' nuclear war between India and Pakistan, with each country detonating 50 Hiroshima-size atom bombs--only about 0.03 percent of the global nuclear arsenal's explosive power--as air bursts in urban areas, could produce so much smoke that temperatures would fall below those of the Little Ice Age of the fourteenth to nineteenth centuries, shortening the growing season around the world and threatening the global food supply. Furthermore, there would be massive ozone depletion, allowing more ultraviolet radiation to reach Earth's surface. Recent studies predict that agricultural production in parts of the United States and China would decline by about 20 percent for four years, and by 10 percent for a decade.” 14. A conflagration involving USA/NATO forces and those of Russian federation would most likely cause the deaths of most/nearly all/all humans (and severely impact/extinguish other species) as well as destroying the delicate interwoven techno-structure on which latter-day 'civilization' has come to depend. Temperatures would drop to below those of the last ice-age for up to 30 years as a result of the lofting of up to 180 million tonnes of very black soot into the stratosphere where it would remain for decades. 15. Though human ingenuity and resilience shouldn't be underestimated, human survival itself is arguably problematic, to put it mildly, under a 2000+ warhead USA/Russian federation scenario. 16. The Joint Statement on Catastrophic Humanitarian Consequences signed October 2013 by 146 governments mentioned 'Human Survival' no less than 5 times. The most recent (December 2014) one gives it a highly prominent place. Gareth Evans’ ICNND (International Commission on Nuclear Non-proliferation and Disarmament) Report made it clear that it saw the threat posed by nuclear weapons use as one that at least threatens what we now call 'civilization' and that potentially threatens human survival with an immediacy that even climate change does not, though we can see the results of climate change here and now and of course the immediate post-nuclear results for Hiroshima and Nagasaki as well.

#### 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.

#### Transition fails—growth bias overwhelms, authoritarian fill-in, and 2008 proves.

Burch-Hansen 18—(Department of Business and Politics, Copenhagen Business School). Hubert Buch-Hansen. “The Prerequisites for a Degrowth Paradigm Shift: Insights from Critical Political Economy,” Ecological Economics, Volume 146, April 2018, pp. 157-163.

Political projects do not become hegemonic just because they embody good ideas. For a project to become hegemonic, (organic) intellectuals first need to develop the project and a constellation of social forces with sufficient power and resources to implement it then needs to find it appealing and struggle for it. In this context, it is worth noting that degrowth, as a social movement, has been gaining momentum for some time, not least in Southern Europe. Countless grassroots' initiatives (e.g., D'Alisa et al., 2013) are the most visible manifestations that degrowth is on the rise. Intellectuals – including founders of ecological economics such as Nicholas Georgescu-Roegen and Herman Daly, and more recently degrowth scholars such as Serge Latouche and Giorgos Kallis – have played a major role in developing and disseminating the ideas underpinning the project. A growing interest in degrowth in academia, as well as well-attended biennial international degrowth conferences, also indicate that an increasing number of people embrace such ideas. Still, the degrowth project is nowhere near enjoying the degree and type of support it needs if its policies are to be implemented through democratic processes. The number of political parties, labour unions, business associations and international organisations that have so far embraced degrowth is modest to say the least. Economic and political elites, including social democratic parties and most of the trade union movement, are united in the belief that economic growth is necessary and desirable. This consensus finds support in the prevailing type of economic theory and underpins the main contenders in the neoliberal project, such as centre-left and nationalist projects. In spite of the world's multidimensional crisis, a pro-growth discourse in other words continues to be hegemonic: it is widely considered a matter of common sense that continued economic growth is required. It is also noteworthy that economic and political elites, to a large extent, continue to support the neoliberal project, even in the face of its evident shortcomings. Indeed, the 2008 financial crisis did not result in the weakening of transnational financial capital that could have paved the way for a paradigm shift. Instead of coming to an end, neoliberal capitalism has arguably entered a more authoritarian phase (Bruff, 2014). The main reason the power of the pre-crisis coalition remains intact is that governments stepped in and saved the dominant fraction by means of massive bailouts. It is a foregone conclusion that this fraction and the wider coalition behind the neoliberal paradigm (transnational industrial capital, the middle classes and segments of organized labour) will consider the degrowth paradigm unattractive and that such social forces will vehemently oppose the implementation of degrowth policies (see also Rees, 2014: 97). While degrowth advocates envision a future in which market forces play a less prominent role than they do today, degrowth is not an anti-market project. As such, it can attract support from certain types of market actors. In particular, it is worth noting that social enterprises, such as cooperatives (Restakis, 2010), play a major role in the degrowth vision. Such enterprises are defined by being ‘organisations involved at least to some extent in the market, with a clear social, cultural and/or environmental purpose, rooted in and serving primarily the local community and ideally having a local and/or democratic ownership structure’ (Johanisova et al., 2013: 11). Social enterprises currently exist at the margins of a system, in which the dominant type of business entity is profit-oriented, shareholder-owned corporations. The further dissemination of social enterprises, which is crucial to the transitions to degrowth societies, is – in many cases – blocked or delayed as a result of the centrifugal forces of global competition (Wigger and Buch-Hansen, 2013). Overall, social enterprises thus (still) constitute a social force with modest power. Ougaard (2016: 467) notes that one of the major dividing lines in the contemporary transnational capitalist class is between capitalists who have a material interest in the carbon-based economy and capitalists who have a material interest in decarbonisation. The latter group, for instance, includes manufacturers of equipment for the production of renewable energy (ibid.: 467). As mentioned above, degrowth advocates have singled out renewable energy as one of the sectors that needs to grow in the future. As such, it seems likely that the owners of national and transnational companies operating in this sector would be more positively inclined towards the degrowth project than would capitalists with a stake in the carbon-based economy. Still, the prospect of the “green sector” emerging as a driving force behind degrowth currently appears meagre. Being under the control of transnational capital (Harris, 2010), such companies generally embrace the “green growth” discourse, which ‘is deeply embedded in neoliberal capitalism’ and indeed serves to adjust this form of capitalism ‘to crises arising from contradictions within itself’ (Wanner, 2015: 23). In addition to support from the social forces engendered by the production process, a political project ‘also needs the political ability to mobilize majorities in parliamentary democracies, and a sufficient measure of at least passive consent’ (van Apeldoorn and Overbeek, 2012: 5–6) if it is to become hegemonic. As mentioned, degrowth enjoys little support in parliaments, and certainly the pro-growth discourse is hegemonic among parties in government.5 With capital accumulation being the most important driving force in capitalist societies, political decision-makers are generally eager to create conditions conducive to production and the accumulation of capital (Lindblom, 1977: 172). Capitalist states and international organisations are thus “programmed” to facilitate capital accumulation, and do as such constitute a strategically selective terrain that works to the disadvantage of the degrowth project. The main advocates of the degrowth project are grassroots, small fractions of left-wing parties and labour unions as well as academics and other citizens who are concerned about social injustice and the environmentally unsustainable nature of societies in the rich parts of the world. The project is thus ideationally driven in the sense that support for it is not so much rooted in the material circumstances or short-term self-interests of specific groups or classes as it is rooted in the conviction that degrowth is necessary if current and future generations across the globe are to be able to lead a good life. While there is no shortage of enthusiasts and creative ideas in the degrowth movement, it has only modest resources compared to other political projects. To put it bluntly, the advocates of degrowth do not possess instruments that enable them to force political decision-makers to listen to – let alone comply with – their views. As such, they are in a weaker position than the labour union movement was in its heyday, and they are in a far weaker position than the owners and managers of large corporations are today (on the structural power of transnational corporations, see Gill and Law, 1989). 6. Consent It is also safe to say that degrowth enjoys no “passive consent” from the majority of the population. For the time being, degrowth remains unknown to most people. Yet, if it were to become generally known, most people would probably not find the vision of a smaller economic system appealing. This is not just a matter of degrowth being ‘a missile word that backfires’ because it triggers negative feelings in people when they first hear it (Drews and Antal, 2016). It is also a matter of the actual content of the degrowth project. Two issues in particular should be mentioned in this context. First, for many, the anti-capitalist sentiments embodied in the degrowth project will inevitably be a difficult pill to swallow. Today, the vast majority of people find it almost impossible to conceive of a world without capitalism. There is a ‘widespread sense that not only is capitalism the only viable political and economic system, but also that it is now impossible to even imagine a coherent alternative to it’ (Fisher, 2009: 2). As Jameson (2003) famously observed, it is, in a sense, easier to imagine the end of the world than it is to imagine the end of capitalism. However, not only is degrowth – like other anti-capitalist projects – up against the challenge that most people consider capitalism the only system that can function; it is also up against the additional challenge that it speaks against economic growth in a world where the desirability of growth is considered common sense. Second, degrowth is incompatible with the lifestyles to which many of us who live in rich countries have become accustomed. Economic growth in the Western world is, to no small extent, premised on the existence of consumer societies and an associated consumer culture most of us find it difficult to completely escape. In this culture, social status, happiness, well-being and identity are linked to consumption (Jackson, 2009). Indeed, it is widely considered a natural right to lead an environmentally unsustainable lifestyle – a lifestyle that includes car ownership, air travel, spacious accommodations, fashionable clothing, an omnivorous diet and all sorts of electronic gadgets. This Western norm of consumption has increasingly been exported to other parts of the world, the result being that never before have so many people taken part in consumption patterns that used to be reserved for elites (Koch, 2012). If degrowth were to be institutionalised, many citizens in the rich countries would have to adapt to a materially lower standard of living. That is, while the basic needs of the global population can be met in a non-growing economy, not all wants and preferences can be fulfilled (Koch et al., 2017). Undoubtedly, many people in the rich countries would experience various limitations on their consumption opportunities as a violent encroachment on their personal freedom. Indeed, whereas many recognize that contemporary consumer societies are environmentally unsustainable, fewer are prepared to actually change their own lifestyles to reverse/address this.

#### Degrowth cancels space colonization.

Kovic 19—(PhD in political communication, University of Zurich). Kovic, Marko. 2019. “The Future of Energy: Energy Prospects for a Budding Inter-Planetary Civilization.” Zurich Institute of Public Affairs.

Second, there is some probability that climate change mitigation strategies will change the social order towards a degrowth philosophy. Degrowth is a vague socio-economic concept and social movement that, in general, calls for a contraction of the global and national economies by means of lower production and consumption rates, and, to some degree, to more profound changes to the “capitalist” system of economic production [67]. Degrowth or degrowth-like approaches are being actively considered as climate risk mitigation strategies [68, 69], and degrowth would almost certainly be a highly effective measure for mitigating climate change. After all, if we were to drastically reduce or even completely eliminate the (industrial) sources of greenhouse gases, the amount of greenhouse gases that are being emitted would accordingly drastically sink. From the long-term perspective of humankind’s survival, degrowth is problematic in at least two ways. First, there is a risk that the general contraction of economic activity would also slow or eliminate progress in the domain of energy, which would, in turn, reduce the probability of successful space colonization due to an absence of suitable energy sources. Second, and more fundamental: If degrowth were to become a dominant societal paradigm, it is uncertain whether the longterm survival of humankind by means of space colonization would be regarded a desirable goal. In a literal sense, establishing extraterrestrial colonies would mean growth; the size of the total human population would grow, and the area of space-time that humans occupy would grow. In a more philosophical sense, degrowth might even be antithetical to space colonization. Even though both degrowth and space colonization have a similar moral goal – increasing wellbeing – , the ends to that goal are very dierent. Within degrowth philosophy, the goal is, metaphorically speaking, not to “live beyond our means”: We should strive for “ecological balance”, and such a state should increase the average wellbeing. But the frame of reference is the status quo; Earth and humankind as we know it today. Space colonization, on the other hand, operates with a much larger frame of reference: All the future generations of humans (and other sentient beings) who could enjoy wellbeing if we succeed in colonizing space – and who will categorically be denied that wellbeing if we fail to colonize space [70]. The goal of space colonization as a moral project is not to live beyond our means, but to actively redene and expand what our means are through scientic and technological progress.

#### Solves inevitable extinction and their impacts.

Zarkadakis 19—(Writer, science communicator, Artificial Intelligence engineer, and digital innovation professional, writes nonfiction books, PhD in Artificial Intelligence). George Zarkadakis. 12-26-19. "Abandoning the metropolis: space colonisation as the new imperative." George Zarkadakis. <https://georgezarkadakis.com/2019/12/26/abandoning-the-metropolis-space-colonisation-as-the-new-imperative/>

Space colonization is not only the subject of fiction but of serious science too. The late physicist Stephen Hawking argued that unless colonies were established in space the human race would become extinct. There are several natural phenomena beyond our control that could spell our obliteration. Over a long enough period of time our planet is vulnerable to catastrophic meteorite strikes, or getting exposed to the deadly radiation of a nearby supernova explosion. As our Sun burns its fuel it will start to expand and, in a few million years, will scorch Earth. We can also self-destruct by waging nuclear war, or by tilting our planet’s climate towards a runaway greenhouse effect. Space colonization is therefore the ultimate insurance policy of long-term human survival[4].

#### Decline causes nuke terror—defense ignores collapsed security infrastructure.

Rothkopf 9—(Visiting Scholar, Carnegie Endowment for International Peace, Testimony before the House Armed Services Committee). David Rothkopf. 3/11/9, http://carnegieendowment.org/files/0311\_testimony\_rothkopf.pdf

The Exacerbation of Critical Threats Associated with Proliferation of Weapons of Mass Destruction The proliferation of weapons of mass destruction remains the greatest threat to global security that we face. While there is no direct linkage between the economic crisis and the technical aspects of proliferation per se, the crisis could well lead to a recruitment bonanza for anti-U.S. non-state actors, greater tensions with hostile nations seeking to lash out at the U.S. as a means of distracting from economic despair at home, reduced resources for sufficient security to prevent proliferation, and the creation of more failed states which become homes to terrorists and criminal organizations that can play a role in WMD proliferation due to their lack of functioning institutional structures.

#### Extinction.

Roth 17—(Nickolas Roth & Matthew Bunn, research associate at the Belfer Center’s Project on Managing the Atom at Harvard University, professor of practice at the Harvard Kennedy School). 9/28/17, “The effects of a single terrorist nuclear bomb”, <https://thebulletin.org/2017/09/the-effects-of-a-single-terrorist-nuclear-bomb/>

And what standards of international order and law would still hold sway? The country attacked might well lash out militarily at whatever countries it thought might bear a portion of responsibility. (A terrifying description of the kinds of discussions that might occur appeared in Brian Jenkins’ book, Will Terrorists Go Nuclear?) With the nuclear threshold already crossed in this scenario—at least by terrorists—it is conceivable that some of the resulting conflicts might escalate to nuclear use. International politics could become more brutish and violent, with powerful states taking unilateral action, by force if necessary, in an effort to ensure their security. After 9/11, the United States led the invasions of two sovereign nations, in wars that have since cost hundreds of thousands of lives and trillions of dollars, while plunging a region into chaos. Would the reaction after a far more devastating nuclear attack be any less? In particular, the idea that each state can decide for itself how much security to provide for nuclear weapons and their essential ingredients would likely be seen as totally unacceptable following such an attack. Powerful states would likely demand that others surrender their nuclear material or accept foreign troops (or other imposed security measures) to guard it. That could well be the first step toward a more profound transformation of the international system. After such a catastrophe, major powers may feel compelled to more freely engage in preventive war, seizing territories they worry might otherwise be terrorist safe havens, and taking other steps they see as brutal but necessary to preserve their security. For this reason, foreign policy analyst Stephen Krasner has argued that “conventional rules of sovereignty would be abandoned overnight.” Confidence in both the national security institutions of the country attacked and international institutions such as the International Atomic Energy Agency and the United Nations, which had so manifestly failed to prevent the devastation, might erode. The effect on nuclear weapons policies is hard to predict: One can imagine new nuclear terror driving a new push for nuclear disarmament, but one could also imagine states feeling more certain than ever before that they needed nuclear weapons.

#### Growth causes transhumanism.

Fuller 17—(Auguste Comte Chair in Social Epistemology in the Department of Sociology at the University of Warwick). Fuller, Steve. 2017. “Transhumanism and the Future of Capitalism: The next Meaning of Life.” London School of Economics Business Review. January 30, 2017. https://blogs.lse.ac.uk/businessreview/2017/01/30/transhumanism-and-the-future-of-capitalism-the-next-meaning-of-life/.

Capitalism is not normally seen as an especially ‘humanistic’ ideology. Yet central to the legal innovations that enabled the rise of capitalism in the early modern West was a doctrine of the person as a being who is free to exchange goods and services. In the eighteenth century, this freedom was characterised as an ‘inalienable right’, which is to say, not transferable to another either by choice or under duress. Thus, a strong normative distinction between people and property was institutionalised, which had not existed in slave or feudal societies. The sting of the Marxist critique of capitalism comes from observing that this distinction is not upheld in practice. Instead a supposedly inalienable right of the person becomes a site for exploitation, as asymmetrical power relations in the marketplace reduces human labour to inhuman capital inputs. Transhumanism challenges the sense of humanity’s ontological stability shared by capitalists and socialists – which has rendered exploitation such a normatively charged issue in the modern era. To be sure, over the past 150 years the potential for exploitation has been mitigated by laws that circumscribe and regulate the role of work in life: While one may need to sell one’s labour to make a living, the buyer doesn’t have unconditional control over the seller’s life. In this context, welfare state legislation has operated as a safeguard against the realisation of Marx’s worst fears. However, whatever sense of humanism has been presumed by such policies is being gradually eroded by the information-based mode of production that characterises what Jean-Francois Lyotard originally called the ‘postmodern condition’. In particular, as computers mediate both the work and non-work aspects of life, many of the phenomenological markers that created distance between the ‘worlds’ of work and non-work are rapidly disappearing. An obvious case in point is the idea of ‘working from home’. People who operate this way typically shift back and forth between performing work and non-work activities on screen in an open-ended and relatively unstructured day. Meanwhile, all the data registered in these activities are gathered by information providers (e.g. Google, Facebook, Amazon), who then analyse and consolidate them for resale to private and public sector clients. Is this exploitation? The answer is not so clear. The information providers offer a platform that is free at the point of use, enabling users to produce and consume data indefinitely. Of course, such platforms are the source of both intense frustration and endless satisfaction for users, but the phenomenology of these experiences is not necessarily what one might expect of people in a state of ‘exploitation’. On the contrary, there is reason to think that people increasingly locate ‘meaning’ in their lives in some cyber-projection (‘avatar’) of themselves, notwithstanding the third-party ownership of the platform hosting the cyber-projection. Transhumanism is strongly implicated in this shift in the scope of one’s ‘personhood’. My own sense of identity may be tied to my having begun life as a member of Homo sapiens at a certain time and place. But that is largely a modern narrative convention, which is tied to what John Locke originally dubbed a ‘forensic’ sense of the person, which is enshrined in modern law – namely, the physical source of an action for whose effects the source is then accountable. Of course, there is scope for this individual to both extend and transfer his or her powers. Thus, the modern period has witnessed an expansion in the remit of corporate law and inheritance law. However, transhumanism takes the process of ‘extending’ and ‘transferring’ the powers of the person to a new level. On the one hand, in the case of extension, the person might incorporate genetically or prosthetically, with the intent of conferring new powers on the original physical individual, as opposed to simply merging the interests of that individual with those of other individuals in the sorts of business arrangements we normally call ‘corporations’. On the other hand, in the case of transfer, the person might do more than simply bequeath various assets to already existing individuals and institutions – say, in a will which comes into force upon one’s death. Rather, the person might in his or her own lifetime invest energy and income in support of virtual agents, ‘second lives’, with the effect of turning one’s physical self into a platform for launching the more meaningful cyber-selves. The state of humanity in such a state of transhumanised capitalism – ‘Capitalism 2.0’, if you will – is one of morphological freedom, as transhumanists themselves put it: It is the freedom not only to do what you want but also to be what you want. It is worth observing that this sense of freedom violates a key metaphysical assumption shared by liberals and socialists, namely, that humans are rough natural equals, not in the sense that everyone is naturally the same but that everyone has roughly the same mix of assets and liabilities, which in turn justifies a harmonious division of labour in society. The violation of this assumption implies that whatever problems of social justice relating to material inequality have emerged over the history of capitalism are potentially amplified by transhumanism, as the prospect of morphological freedom explodes stopgap liberal intuitions about the ‘natural equality’ of humans.

#### That solves extinction from disease, space col, and AI.

Sandberg 14—(Faculty of Philosophy, The Future of Humanity Institute & Oxford Martin School, University of Oxford). Sandberg, Anders. 2014. “Ethics of Brain Emulations.” Journal of Experimental & Theoretical Artificial Intelligence 26 (3): 439–57. https://doi.org/10.1080/0952813X.2014.895113.

On the other hand, there at least four major ways emulations might lower the risks of Earth originating intelligence going extinct: First, the existence of non-biological humans would ensure at least partial protection from some threats: there is no biological pandemic that can wipe out software. Of course, it is easy to imagine a digital disaster, for example an outbreak of computer viruses that wipe out the brain emulations. But that threat would not affect the biological humans. By splitting the human species into two, the joint risks are significantly reduced. Clearly, threats to the shared essential infrastructure remain, but the new system is more resilient. Second, brain emulations are ideally suited for colonising space and many other environments where biological humans require extensive life support. Avoiding carrying all eggs in one planetary basket

is an obvious strategy for strongly reducing existential risk. Besides existing in a substrate-independent manner where they could be run on computers hardened for local conditions, emulations could be transmitted digitally across interplanetary distances. One of the largest obstacles of space colonisation is the enormous cost in time, energy and reaction mass needed for space travel: emulation technology would reduce this. Third, another set of species risks accrue from the emergence of machine superintelligence. It has been argued that successful artificial intelligence is potentially extremely dangerous because it would have radical potential for self-improvement, yet possibly deeply flawed goals or motivation systems. If intelligence is defined as the ability to achieve one’s goals in general environments, then superintelligent systems would be significantly better than humans at achieving their goals – even at the expense of human goals. Intelligence does not strongly prescribe the nature of goals (especially in systems that might have been given top-level goals by imperfect programmers). Brain emulations get around part of this risk by replacing the de novo machine intelligence with a copy of the relatively well-understood human intelligence. Instead of getting potentially very rapidly upgradeable software minds with non-human motivation systems, we get messy emulations that have human motivations. This slows the ‘hard takeoff’ into superintelligence, and allows existing, well-tested forms of control over behaviour – norms, police, economic incentives, political institutions – to act on the software. This is by no means a guarantee: emulations might prove to be far more upgradeable than we currently expect, motivations might shift from human norms, speed differences and socioeconomial factors may create turbulence, and the development of emulations might also create spin-off artificial intelligence. Fourth, emulations allow exploration of another part of the space of possible minds, which might encompass states of very high value (Bostrom, 2008).

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#### They have it backwards—they ignore immaterial decoupling.

Phillips 19—(environmental journalist, has written for Nature, the Guardian, the Daily Telegraph, the New Statesman, Businessweek and the EUobserver). Phillips, Leigh. 2019. “The Degrowth Delusion.” openDemocracy. August 30, 2019. <https://www.opendemocracy.net/en/oureconomy/degrowth-delusion/>.

One important paper from degrowth advocates argues that this is simply because traded goods have a greater material impact than merely what is incorporated into them (think of the difference between an ingot of steel versus raw iron ore). Once this is taken into account, suggests another paper by a leading degrowth advocate, OECD absolute decoupling reveals itself to be a mirage, and globally economic growth remains as coupled to use of materials as ever—although, interestingly, that same paper notes this is primarily a result of offshoring of just construction materials. But this is a global consideration of material inputs, so a range of sectoral absolute decouplings goes unnoticed, and global ones that are immaterial are likewise ignored. CFC absolute decoupling is global but unrecognized because measurement of material inputs doesn’t capture this. The sharp reduction in emissions of carbon monoxide, sulphur dioxide, nitrogen oxides, lead and particulate in Europe and America has come from regulation; they have not shifted overseas. US agricultural absolute decoupling has likewise not been a product of offshoring, as inputs here are primarily domestically sourced. A global decoupling of greenhouse gas emissions from growth (in principle feasible, but very far from being implemented) likewise would be missed by such an analysis. And even more importantly, the very fact that there has already been a great many demonstrable examples of regional and global absolute decoupling in different sectors disproves the claim of the impossibility of absolute decoupling. The only question that remains is whether absolute decoupling can be extended across all sectors, or sufficient sectors as to eliminate undermining of ecosystem services.

#### Renewables scale and solve—they ignore efficiency boosts from machine learning.

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.

Energy. One of humanity’s most urgent tasks in the twenty-first century is to reduce greenhouse gas emissions. Two ways to do this are to become more efficient in using energy and, when generating it, to shift away from carbon-emitting fossil fuels. Digital tools will help greatly with both. Several groups have recently shown that they can combine machine learning and other techniques to increase the energy efficiency of data centers by as much as 30 percent. This large improvement matters for two reasons. First, data centers are heavy users of energy, accounting for about 1 percent of global electricity demand. So efficiencies in these facilities help. Second, and more important, these gains indicate how much the energy use of all our other complicated infrastructures—everything from electricity grids to chemical plants to steel mills—can be trimmed. All are a great deal less energy efficient than they could be. We have both ample opportunity and ample incentive now to improve them. Both wind and solar power are becoming much cheaper, so much so that in many parts of the world they’re now the most cost-effective options, even without government subsidies, for new electrical generators. These energy sources use virtually no resources once they’re up and running and generate no greenhouse gases; they’re among the world champions of dematerialization. In the decades to come they might well be joined by nuclear fusion, the astonishingly powerful process that takes place inside the sun and other stars. Harnessing fusion has been tantalizingly out of reach for more than half a century—the old joke is that it’s twenty years away and always will be. A big part of the problem is that it’s hard to control the fusion reaction inside any human-made vessel, but massive improvements in sensors and computing power are boosting hope that fusion power might truly be only a generation away.

#### Yes ROI for renewables.

Wetstone 19—(JD from Duke, BS in Biology from Florida State, former Chief Counsel for Environment at the US House of Representatives Committee on Energy and Commerce). Wetstone, Gregory. 2019. “Renewable Energy Is Booming. Here’s How to Keep It Going.” Fortune Magazine. July 2, 2019. https://fortune.com/2019/07/02/renewable-solar-wind-energy-investment/.

Renewable energy is one of the most attractive investment options for American companies today. Just ask Starbucks, which recently contracted for enough wind and solar power to supply 3,000 of its coffee shops with clean electricity. American businesses and global investors are increasingly turning to a low-carbon portfolio—a fact reflected in our new survey of the nation’s leading financial institutions, which found high near-term confidence for renewable energy growth over the next three years and a strong appetite for energy storage. When asked their reasons for this bullish outlook, survey respondents cited the low cost of renewable energy, expanded requirements that states derive a certain portion of their energy from renewable sources, increased demand from corporations, the potential for new carbon legislation, and a desire to benefit from sunsetting tax credits.

#### Clary is too limited—just about rivalries, only 100 samples, and ignores World Wars—prefer our ev that provides theoretical and empirical examples.

Clary 15—(Massachusetts Institute of Technology Political Science Department). Christopher Clary. “Economic Stress and International Cooperation: Evidence from International Rivalries,” Research Paper No. 2015--8, “Economic Stress and International Cooperation: Evidence from International Rivalries,” <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2597712>.

Abstract Do economic downturns generate pressure for diversionary conflict? Or might downturns encourage austerity and economizing behavior in foreign policy? This paper provides new evidence that economic stress is associated with conciliatory policies between strategic rivals. For states that view each other as military threats, the biggest step possible toward bilateral cooperation is to terminate the rivalry by taking political steps to manage the competition. Drawing on data from 109 distinct rival dyads since 1950, 67 of which terminated, the evidence suggests rivalries were approximately twice as likely to terminate during economic downturns than they were during periods of economic normalcy. This is true controlling for all of the main alternative explanations for peaceful relations between foes (democratic status, nuclear weapons possession, capability imbalance, common enemies, and international systemic changes), as well as many other possible confounding variables. This research questions existing theories claiming that economic downturns are associated with diversionary war, and instead argues that in certain circumstances peace may result from economic troubles. Defining and Measuring Rivalry and Rivalry Termination I define a rivalry as the perception by national elites of two states that the other state possesses conflicting interests and presents a military threat of sufficient severity that future military conflict is likely. Rivalry termination is the transition from a state of rivalry to one where conflicts of interest are not viewed as being so severe as to provoke interstate conflict and/or where a mutual recognition of the imbalance in military capabilities makes conflict-causing bargaining failures unlikely. In other words, rivalries terminate when the elites assess that the risks of military conflict between rivals has been reduced dramatically. This definition draws on a growing quantitative literature most closely associated with the research programs of William Thompson, J. Joseph Hewitt, and James P. Klein, Gary Goertz, and Paul F. Diehl.1 My definition conforms to that of William Thompson. In work with Karen Rasler, they define rivalries as situations in which “[b]oth actors view each other as a significant politicalmilitary threat and, therefore, an enemy.”2 In other work, Thompson writing with Michael Colaresi, explains further: The presumption is that decisionmakers explicitly identify who they think are their foreign enemies. They orient their military preparations and foreign policies toward meeting their threats. They assure their constituents that they will not let their adversaries take advantage. Usually, these activities are done in public. Hence, we should be able to follow the explicit cues in decisionmaker utterances and writings, as well as in the descriptive political histories written about the foreign policies of specific countries.3 Drawing from available records and histories, Thompson and David Dreyer have generated a universe of strategic rivalries from 1494 to 2010 that serves as the basis for this project’s empirical analysis.4 This project measures rivalry termination as occurring on the last year that Thompson and Dreyer record the existence of a rivalry.5

#### That causes extinction

Robert A. Denemark 18, Associate Professor of Political Science and International Relations at the University of Delaware, 2018, “Nuclear War in the Rivalry Phase of the Modern World-System,” Journal of World-Systems Research, Vol. 24, No. 2, p. 348-371

Students of world-systems analysis should reconsider the great power dynamics of the rivalry phase, which constitutes an existential threat given the resurrection of nuclear weaponry.1 My argument proceeds in three parts. First, I briefly review the nature of conflict in the rivalry phase, and predictions regarding its timing. Second, I consider the persistence and impact of nuclear weapons, and the dangerous logic of nuclear confrontation as it evolved in the context of both old and new nuclear states. Finally, I consider the set of processes that influence the chances for nuclear war as outlined by Chase-Dunn and Podobnik in the very first volume of this journal. I outline the manner in which the forces they identified as leading toward war have continued to develop, while those that might reduce the probability of conflict have weakened.

This formulation of the cycle of hegemony and rivalry, our possession of nuclear weapons for the first time during the rivalry phase, the return of unstable nuclear confrontation, the novel context presented by new nuclear powers, increased complexity, the decline of impediments to conflict, and the increase in global tension, suggest a new and more threatening global environment. Students of world-systems analysis have much to contribute to this analysis and should consider investing additional attention to these processes.

The question of systemic war dissipated in the wake of the dissolution of the USSR, the political consolidation and economic integration of the core, the neo-liberal neutering of the periphery, and China’s non-confrontational transition strategy. Naïve pronouncements about the end of history, and models of limitless beneficial globalization, flowed from other academic quarters. But a series of tensions emerged from xenophobic plebiscites, populist electoral outcomes, attempts to disarticulate the global economy, and the use of nuclear threats by a resurgent Russia, a recalcitrant North Korea, and the current U.S. administration. Systemic war, including nuclear exchanges, no longer seem so unlikely.

I argue that from a world-systems perspective, the chances of nuclear conflict have increased, and will continue to do so as we move deeper into a period of systemic rivalry. In an important sense, the immediate future is more dangerous than the nuclear brinksmanship that emerged in the Cold War. While much of world-systems analysis has focused on the continuing plight of the periphery, under the circumstances it would make sense to undertake more of an effort to understand the dynamics of rivalry and nuclear conflict.