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**Advantage 1 is Innovation —**

**Standards-Setting Organizations** [SSO’s] **are industry members who jointly establish standards for information tech defined by the adoption of standard-essential patents** [SEP’s]**, which are licensed to companies who wish to implement the tech in their product, called implementers, on Fair, Reasonable, and Non-Discriminatory** [FRAND] **terms. Current standards promote price gouging, FRAND enforcement is critical.**

**Melamed & Shapiro 18**, \*A. Douglas Melamed is Professor of the Practice of Law at Stanford Law School; \*Carl Shapiro is the Transamerica Professor of Business Strategy at the Haas School of Business at the University of California at Berkeley; (May 2018, “How Antitrust Law Can Make FRAND Commitments More Effective”, https://www-cdn.law.stanford.edu/wp-content/uploads/2018/05/How-Antitrust-Law-Can-Make-FRAND-Commitments-More-Effective.pdf)

I. Standard Setting and the Competitive Process

The **fundamental economics** in the **information technology** sector, driven by **network effects**, implies that there is **enormous value** associated with establishing compatibility standards. Popular standards include the mobile broadband standards used in cell phones, which are established by the 3rd Generation Partnership Project (3GPP), and the Wi-Fi technology for wireless local area networks, which is enabled by the 802.11 standard established by the Institute of Electrical and Electronics Engineers (IEEE).4

There are many SSOs, and their rules and procedures differ considerably. In addition to IEEE, leading SSOs include the International Organization for Standardization (ISO), the International Telecommunication Union (ITU), the European Telecommunications Standards Institute (ETSI), the Internet Engineering Task Force (IETF), and the World Wide Web Consortium (W3C).5 SSOs generally establish standards by holding a series of committee meetings among industry participants. These meetings culminate in a vote on a technical specification that describes what features or attributes a product must have in order to comply with the standard. Most SSOs are open to all industry participants and seek to operate on a consensus basis, applying certain voting rules. SSOs do not normally engage in patent licensing, nor do they specify how patent royalties will be divided up among patent holders. They leave that to their members, which in some cases form patent pools to address these issues.6

SSOs adopt specific policies relating to intellectual property rights (IPRs).7 These IPR policies are generally intended to enable the SEP holders to obtain reasonable royalties for licensing their patents, while prohibiting them from charging excessive royalties after other industry participants have committed to the standard. At that point, firms committed to implementing the standard— which we call “implementers”—would find it **very costly** to avoid using the patented technology. For this purpose, most SSOs require SEP owners to license their SEPs on FRAND terms.8

FRAND policies are especially necessary because negotiations between SEP holders and implementers generally **take place only after** the implementers have used and infringed the technologies claimed by the SEPs. Standards involving information and communications technology can involve hundreds or even **thousands of SEPs**, many with **uncertain boundaries** for infringement. In addition, a time lag exists between patent application and patent issuance. For these and other reasons, it is **impractical** for implementers to enter into negotiations for patent licenses with all SEP owners prior to the establishment of a standard and to their implementation of it.9

The fact that patent negotiations generally do not take place until after implementers have used and infringed the technologies has several critical implications. First, at the time of negotiation, implementers are **locked into the standard** and the technologies claimed by the SEPs—that is, the **cost to switch** to an alternative technology or standard at that point—ex post—is **much greater** than it was ex ante, before the patented technology was first included in the standard. Ex post, the patent holder is no longer competing to have its technology included in the standard, nor is it competing to have implementers of the standard use its technology. Instead, because the patent holder owns an asset that is essential to the standard, implementers have no choice but to use the patented technology.

If the standard is commercially successful, implementers are willing to pay a much larger royalty for use of the patented technology than they would have paid ex ante, when the SEP holder faced competition from other technologies. In these circumstances, the SEP holder can be said to have obtained **monopoly power** in the market in which the patented technology is licensed for use in implementing the standard.10

Second, because of lock-in and the implementer’s ongoing infringement, the **potential for litigation looms large** in licensing negotiations. In effect, the parties are negotiating about how to settle an infringement suit, and that negotiation is **heavily influenced** by their predictions as to what the court will do if they cannot agree. This situation is not unique to SEPs; it arises frequently when firms are faced with patent infringement claims for products they have independently developed or technologies they have inadvertently infringed. Patent law addresses such instances by specifying that patent holders are entitled to “**reasonable royalties**,” defined as the royalties that the parties would have negotiated prior to the infringement and thus prior to lock-in.11 Those hypothetical ex ante royalties reflect the market value of the patent license. Notwithstanding the law’s embrace of this principle, however, as a practical matter, patent holders are **generally able to recover more** than the **ex ante value** of the patent when litigation occurs after the implementers are locked in. Further, negotiations in the shadow of litigation after lock-in tend to **result in royalties in excess** of the ex ante or **market value** of the patented technology.12

Third, the shadow of litigation is **particularly problematic** in the communications and technology sector, in which products typically include hundreds or **thousands** of **patented technologies**. A court-ordered injunction involving such products would deprive the implementer of not only the value of the technology covered by the patent-in-suit, but also the value of the **entire product**.13 Implementers that are forced to bear the risk of an injunction are thus **induced to agree to royalties** greater than those that would be **appropriate** if only the value of the patented technology were at stake. Those royalties **systematically provide** SEP holders with **excessive compensation** in comparison with the benchmark of ex ante royalties.

These implications of lock-in and ex post dealings are well-understood: they represent an example of the **general concept** of **lock-in** and **opportunism** developed by Oliver Williamson.14 The Federal Circuit has also recognized the market distortions caused by the inclusion of patented technologies in public standards and the resulting danger of patent holdup involving SEPs.15

For these and other reasons, the SEP holder has ex post monopoly power that, if left unchecked, would enable it to obtain royalties **far in excess** of the royalties that it could earn in a competitive market.16 To address this common problem and limit ex post opportunism by SEP holders, SSOs typically require participants that own SEPs to make certain FRAND commitments. In particular, by requiring a commitment to license on “fair and reasonable” terms, the FRAND requirement aims to prevent, or at least reduce, the **extent of monopoly pricing** by SEP holders. And by requiring a commitment to license on “nondiscriminatory” terms, the FRAND requirement can prevent SEP holders from **extracting monopoly premiums** by selective licensing or, more important, migrating their monopoly power from the FRAND-regulated market to unregulated standard-implementing product markets by licensing to only one or a few implementers or licensing to selected implementers on discriminatorily favorable terms.

**Patent holdup is accentuated by the Ninth Circuit’s recent decision in *FTC v. Qualcomm* that permits ICT firms to engage in innovation-stifling conduct with antitrust impunity.**

**Moss 20**, \*Alex Moss is a Staff Attorney on EFF’s intellectual property team, before joining EFF, Alex practiced complex commercial litigation at Sullivan & Cromwell LLP in New York and Durie Tangri LLP in San Francisco; (August 26th, 2020, “Throwing Out the FTC's Suit Against Qualcomm Moves Antitrust Law in the Wrong Direction”, https://www.eff.org/deeplinks/2020/08/throwing-out-ftcs-suit-against-qualcomm-moves-antitrust-law-wrong-direction)

Standards can enhance **competition** and **consumer choice**, but they also **massively inflate** the **value** of **patents** deemed **essential** to the standard, and give their owners the power to **sue companies** that implement the standard for **money damages** or **injunctions** to block them from using their SEPs. When standards cover critical features like wireless connectivity, SEP owners wield a huge amount of **“hold-up” power** because their patents allow them to effectively **block access** to the **standard** altogether. That lets them charge **unduly large tolls** to anyone who wants to implement the standard.

To minimize that risk, standard-setting organizations typically require companies that want their patented technology incorporated into a standard to promise in advance to license their SEPs to others on fair, reasonable, and non-discriminatory (FRAND) terms. But that promise strikes at a **key tension** between antitrust and patent law: patent owners have **no obligation** to let anyone use technology their patent covers, but to get those technologies incorporated into standards, patent owners usually have to promise that they will give **permission** to anyone who wants to implement the standard as long as they pay a reasonable license fee.

Qualcomm is one of the most **important** and **dominant** companies in the **history** of **wireless** communication standards. It is a multinational conglomerate that has owned patents on every major wireless communication standard since its first CDMA patent in 1985, and it **participates** in the **s**tandard-**s**etting **o**rganization**s** that define those standards. Qualcomm is somewhat unique in that it not only **licenses SEPs**, but also **supplies** the **modem chips** used by a wide range of devices. These include chips that **implement** wireless communication **standards**, which lie at the **heart** of every mobile **computing device**.

Although Qualcomm promised to license its SEPs (including patents essential to CDMA, 3G, 4G, and 5G) on FRAND terms, its conduct has to many looked **unfair**, **unreasonable**, and **highly discriminatory**. In particular, Qualcomm has drawn scrutiny for bundling tens of thousands of patents together—including many that are **not** standard-**essential**—and offering portfolio-only licenses no matter what licensees actually **want** or **need**; refusing to sell modem chips to anyone without a SEP license and threatening to **withhold chips** from companies trying to **negotiate** different license terms; **refusing** to license anyone other than original-equipment manufacturers (OEMs); and insisting on **royalties** calculated as a **percentage** of the **sale price** of a handset sold to end users for hundreds of dollars, despite the minimal contribution of any particular patent to the retail value.

In 2017, the U.S. Federal Trade Commission [sued](https://www.ftc.gov/news-events/press-releases/2017/01/ftc-charges-qualcomm-monopolizing-key-semiconductor-device-used) Qualcomm for violating both sections of the Sherman Antitrust Act by engaging in a number of anticompetitive SEP licensing practices. In May 2019, the U.S. District Court for the Northern District of California agreed with the FTC, identifying numerous instances of Qualcomm’s unlawful, anticompetitive conduct in a comprehensive [233-page opinion](https://www.eff.org/document/ftc-v-qualcomm-district-court-opinion). We were pleased to see the FTC take action and the district court credit the overwhelming evidence that Qualcomm’s conduct is corrosive to market-based competition and threatens to cement Qualcomm’s dominance for years to come.

But this month, a panel of judges from the Court of Appeals for the Ninth Circuit unanimously [overturned](https://www.eff.org/document/ninth-circuit-opinion-ftc-v-qualcomm) the district court’s decision, reasoning that Qualcomm’s conduct was “hypercompetitive” but not “anticompetitive,” and therefore not a violation of antitrust law. To reach that result, the Ninth Circuit made the patent grant more powerful and antitrust law weaker than ever.

According to the Ninth Circuit, patent owners don’t have a duty to let anyone use what their patent covers, and therefore Qualcomm had no duty to license its SEPs to anyone. But that framing requires **ignoring** the **promises** Qualcomm made to license its SEPs on **reasonable** and **non-discriminatory** terms—promises that courts in this country and around the world have **consistently** enforced. It also means ignoring antitrust principles like the essential facilities doctrine, which limits the ability of a monopolist with **hold-up power** over an **essential facility** (like a port) to **shut out** rivals. Instead, the Ninth Circuit held rather simplistically that a duty to deal could arise only if the monopolist had provided access, and then reversed its policy.

But even when Qualcomm restricted its licensing policies in critical ways, the Ninth Circuit found reasons to approve those restrictions. For example, Qualcomm stopped licensing its patents to chip manufacturers and started licensing them only to OEMs. This had a major benefit: it let Qualcomm charge a much **higher royalty rate** based on the **high retail price** of the end user devices, like smartphones and tablets, that OEMs make and sell. If Qualcomm had continued to license to chip suppliers, its patents would be “**exhausted**” once the chips were sold to OEMs, extinguishing Qualcomm’s right to assert its patents and control how the chips were used.

Patent exhaustion is a century-old doctrine that protects the rights of consumers to use things they buy without getting the patent owner’s permission again and again. Patent exhaustion is important because it **prevents price-gouging**, but also because it protects **space** for **innovation** by letting people **use things** they buy **freely**, including to build innovations of their own. The doctrine thus helps patent law serve its underlying goal—promoting economic **growth** and **innovation**. In other words, the doctrine of exhaustion is baked into the patent grant; it is not optional. Nevertheless, the Ninth Circuit wholeheartedly approved of Qualcomm’s efforts to avoid **exhaustion**—even when that meant **cutting off** access to **previous licensees** (chip-makers) in ways that let Qualcomm charge **far more** in **licensing fees** than its SEPs **could possibly** have **contributed** to the **retail value** of the **final product**.

It makes **no sense** that Qualcomm could **contract around** a fundamental principle like patent **exhaustion**, but at the same time **did not assume** any **antitrust duty** to deal under these circumstances. Worse, it’s **harmful** for the **economy**, **innovation**, and **consumers**. Unfortunately, the kind of harm that antitrust law recognizes is limited to harm affecting “competition” or the “competitive process.” Antitrust law, at least as the Ninth Circuit interprets it, doesn’t do nearly enough to address the **harm** downstream consumers experience when they pay **inflated** prices for high-tech devices, and miss out on **innovation** that might have developed from fair, reasonable, and non-discriminatory licensing practices.

We hope the FTC sticks to its guns and asks the Ninth Circuit to go en banc and reconsider this decision. Otherwise, antitrust law will become an even **weaker weapon** against **innovation-stifling conduct** in **technology markets.**

**Weakened antitrust enforcement emboldens firms to follow Qualcomm’s lead, which collapses FRAND integrity.**

**Hovenkamp 20**, \*Herbert J. Hovenkamp is James G. Dinan University Professor at the University of Pennsylvania Law School and the Wharton School of the University of Pennsylvania; (2020, “FRAND and Antitrust”, <https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=3095&context=faculty_scholarship>)

While the FRAND process has been highly productive, it is also **fragile**. Firms are tempted to make commitments at the beginning when the incentive to join is large, but **renege** on them **later** when they can profit by doing so. At least in this particular case, private FRAND enforcement **had not worked** very well. Qualcomm had been able to violate FRAND commitments in order to **exclude rivals** and obtain **higher royalties** than FRAND would permit, largely with **impunity**. Other firms will very likely **follow Qualcomm’s lead**. If that happens the **FRAND system** will **fall apart**, doing **irreparable injury** to the modern wireless telecommunications network or, at the very least, **diminishing** the **leadership role** of the United States in preserving effective **network competition**.

While governments can be heavily involved in standard set-ting,9 the implementation of technical standards in information technologies is largely the work of private actors. Government involvement is limited mainly to enforcement of contract, intellectual property, or antitrust law. As private actors, those involved in standard setting or compliance are fully subject to the federal antitrust laws.

This Article addresses one question: when is an SSO participant’s violation of a FRAND commitment an antitrust violation, and if it is, of what kind and what are the implications for remedies? It warns against two extremes. One is thinking that any violation of a FRAND commitment is an antitrust violation as well. In the first instance FRAND obligations are contractual, and most breaches of contract do not violate any antitrust law. The other extreme is thinking that, because a FRAND violation is a breach of contract, it cannot also be an antitrust violation. The question of an antitrust violation does not de-pend on whether the conduct breached a particular agreement but rather on whether it caused competitive harm. This can happen because the conduct restrained trade under section 1 of the Sherman Act, was unreasonably exclusionary under section 2 of the Sherman Act, or amounted to an anticompetitive condition or understanding as defined by section 3 of the Clay-ton Act.10 The end goal is to identify practices that harm com-petition, thereby injuring consumers.

The Ninth Circuit’s Qualcomm decision will make antitrust violations in the context of FRAND licensing much more **difficult to prove**, even in cases where **anticompetitive behavior** and consumer harm **seem clear**.11 Indeed, in this case the court itself acknowledged the harm to consumers but appeared to think that they were not entitled to protection.12 If this decision stands, FRAND obligations will to a **larger extent** have to be settled through private litigation and the federal antitrust enforcement agencies will have a **diminished role**. Anticompetitive behavior by one firm that is **not effectively disciplined** will lead **others** to do the **same thing**.

**A trusted and credible system for ICT innovation is critical to rapid tech diffusion and economic growth---absent FRAND, the system will collapse.**

**Bauer et al. 17**, \*Matthias Bauer is Senior Economist at ECIPE; \*Fredrik Erixon is a Swedish economist and writer. He has been the Director of the European Centre for International Political Economy (ECIPE) ever since its start in 2006; (October 2017, “Standard Essential Patents and the Quest for Faster Diffusion of Technology”, https://ecipe.org/publications/standard-essential-patents/)

It is easy to take a **pessimistic view** about whether the system will **break**. If the current trend continues, the system is **likely** to break at **some point** for the simple reason that companies will **not trust it** anymore. The series of legal disputes witnessed over the past years – sometimes referred to as the “smartphone patent wars” – has been fodder for a pessimistic reading of “the two tales of SEPs”. While it is common in the business world that disputes over patents and licenses are settled in courts, various SEP disputes have revealed **problematic** aspects of the SEP market that are different from those disputes that follow the normal stream of business and contracts. Often, the SEP disputes are less concerned about the rights and boundaries of patents, and more about **antitrust limits** to market **behavior**: they concern market **abusive practices** and **restrictions** to **competition** as much as they are about intellectual property.

If the SEP system actually **does break** at some point, the consequences would be **felt** throughout the **economy**. SEPs have been a **critical part** of the ICT revolution. SEPs have allowed for the **fast rates** of innovation **diffusion** that the world has witnessed over the **past quarter** of a **century**. All the computer and Internet related products and services that people are now dependent upon for their private and professional lives are **intricate webs** of intellectual property. As many as 250,000 patents can be used to claim ownership of some technical specification or design element in a single smartphone (NYT 2012). A laptop, suggests one calculation, implements more than 250 interoperability standards (Biddle et al. 2010), and the number of SEP holders for 3G and 4G standards grew from 2 in 1994 to 130 in 2013 while the number of SEPs rose from fewer than 150 in 1994 to more than 150,000 in 2013 (Galetovic and Gupta 2016). The standardization-body ETSI has registered more than 150,000 declarations of SEPs from companies, and ETSI is just one of many bodies in the world of ICT standardization. For the 3G standard, the same body has about 24,000 patents that have been declared essential. Now, with the economy yet again on the **threshold** of big technological change, a **trusted** and **credible system** for creators and users of technology to standardize proprietary technology would be a boon for **innovation**, **interoperability** and – ultimately – the **consumers**.

And there are reasons for optimism. Although many of the problems in the SEP regimes need to be addressed, the numbers above indicate that the SEP system is in fact attractive to patent holders and SEP implementers. It is easy to see why: neither holders nor implementers are presented with alternative options that on the face of it would be far more profitable for them. In other words, there simply would not be as many patents declared as essential if both creators and users of technology believed the SEP system worked to their disadvantage or was grossly unfair. While the reality for some companies may be that legal disputes and unpredictability prompt them to find other ways than SEPs to get access to key technologies for their products, it remains the case that most stakeholders have strong economic incentives to maintain a balanced SEP system that is trusted.

First, standard essential patents are an asset for creators of technology because, by becoming **essential** to a standard, their volumes of sales for technologies that users value rise **significantly**. As many holders want to raise more revenues for their SEPs and – ideally – have the freedom to contract with buyers on their terms, they can expand their customer base when they agree to sell patented technology in accordance with a set of rules that are designed to prevent SEP holders exploiting the weakness of a customer that has grown dependent on having access to their technology.

Second, SEPs are hugely **beneficial** also to those that buy the licenses – the implementers or users. Through the SEP system, they can access technologies that are **interoperable** and work with different **products** and **functionalities** – and they can do it under conditions that, if history is a guide, in most cases give them stable and predictable terms of contract. As a consequence, both creators and users can focus on their competitive advantages and profit on the economies of scale and specialization. Downstream firms do not need to develop their own upstream technology and upstream firms do not need to package their technologies in end-customer products in order to make their products valuable.

Third, standard-setting organisations (SSOs) also have a big stake in an SEP system that works well – and, like creators and users of technology, they would stand to lose significantly if the SEP system were to collapse.

Lastly, the biggest beneficiaries are individual consumers – those who buy the end products using FRAND-conditioned SEPs. The advent of SEPs and the rules represented by FRAND have enabled a **development** of fast technology creation and contributed to the **rapid diffusion** in ICT goods and ICT-based services. The SEP system has also allowed for new competition, both between existing technologies and brands, and from new ones that have stepped into the market with the ambition to disrupt it, again to the benefit of the consumer. It is **difficult** to imagine that the ICT and digital **development** would have been as **fast** as it has been if SEPs had not been a **central feature** of the **market**.

The changing fortunes of companies operating in the cellular and smartphone market would not have been possible if there had not been an SEP system that supported competition. Now that the **world economy** is on the **doorstep** of new innovations that are dependent on a great number of input technologies – e.g. the Internet-of-Things, transport connectivity and intelligent vehicles – it is **crucially important** for the consumer that a **balanced** and **functioning** SEP system is maintained and that actors in the system **converge** towards it – which would ultimately **meet** their **economic interests**.

**ICT innovation is key to post-COVID economic recovery and long-term growth.**

**van Ark 21**, \*Bart van Ark is a Senior Advisor of the Economy, Strategy and Finance (ESF) Center at The Conference Board; Bart van Ark, \*Klaas de Vries is an economist with The Conference Board; \*Abdul Erumban is an assistant professor at the University of Groningen, The Netherlands and a senior research fellow at The Conference Board; (2021, “HOW TO NOT MISS A PRODUCTIVITY REVIVAL ONCE AGAIN”, https://sci-hub.se/10.1017/nie.2020.49)

Introduction

As the global economy has entered recession in 2020, triggered by the COVID-19 pandemic, the human casualties, and economic **damage** are perceived to be **very large**. Even as the health crisis will gradually become manageable, the impact on economic growth can be **long-lasting** and the recovery path can take several **years**. In particular, growth drivers such as the pace of job creation, income generation and investment may take several years to get back to pre-crisis trends. Initially the productivity of those growth drivers may be of less concern as the mantra of ‘we’ll do what it takes to avoid worse’ is predominant in this phase of the crisis.

However, once the recovery gets underway the **productive** use of **resources** is key to **sustained** growth. While we do not ignore the short-term challenges of the economic recovery, our primary focus in this paper is on the productivity puzzle from a **long-term** perspective. Productivity is driven by technological **change** and **innovation** which, in turn, depends on **investment** in human and physical capital as well as in other ‘missing capitals’ often referred to as intangible assets. Indeed, those investments create a **positive feedback** effect, as the productivity it generates also helps to make more **efficient** usage of **scarce** resources in the future. When properly measured and valued, productivity also provides a critical yardstick to realise a fairer distribution of the gains from economic growth to those who bring the resources to bear. It thereby creates the incentives for people to produce and business to invest helping to drive economic growth and raise living standards.

Unfortunately, in the aftermath of the global financial crisis of 2008/2009, many economies around the world, especially advanced economies, have failed to recharge the economy by powering productivity as the key source of growth in the long term. Indeed the latest update of The Conference Board Total Economy Database (July 2020) points at significant weakening in labor productivity growth in Europe up to 2019 (figure 1a–c). While the United States experienced somewhat faster productivity growth from 2017 to 2019 than the Euro Area and the United Kingdom, it still has **not recovered** to the rates of productivity growth from before the global financial crisis either.

The slowdown in productivity growth over the past 15 years has been well documented. There are multiple causes including an exhaustion of catch-up potential in emerging markets impacting economies along entire global value chains, and the drag from the global financial crisis because of low demand and weak investment, too low interest rates causing misallocations an overreliance on cheap labor, and failing fiscal policies (Bauer et al., 2020; Cette et al., 2016; Crafts, 2018; Dieppe, 2020; Fernald et al., 2017; Syverson, 2016).1 Technical measurement issues regarding inputs and outputs may have played a role as well.

In our earlier work we have stressed the importance of time lags in the adoption of new technologies, and in particular the complexity in generating productivity growth from the latest round of new digital technologies since the early 2010s, including the move toward mobile, ubiquitous access to broadband, the rise of cloud storage and advances in artificial intelligence (AI) and robotics (van Ark, 2016a, 2016b; van Ark and O’Mahony, 2016; van Ark et al., 2016).

While the first priority for economic recovery from the COVID-19 crisis is to restore jobs, it is important that any employment-intensive growth path does go together with a **productivity revival**. In this paper, we argue that it is possible to avoid another productivity **slowdown**. Underneath the aggregate figures, there is evidence pointing toward a possible **tipping point** at which many advanced economies may expect to see more **widespread** impacts from the adoption and absorption of **digital technology** on **productivity** and GDP **growth**.

In Section 2 we review the latest literature on the productivity impacts of general purpose technologies (GPTs), including the notion of time lapses through which digital technologies result in faster productivity growth. We also look at patterns by which innovation and productivity effects GPTs emerge across industries and disperse across the economy. We explain why the New Digital Economy (NDE) is especially characterised by long lag effects.

In Section 3 we provide an empirical analysis of productivity growth by industry data to observe whether we can detect a distinct pattern across groups of industries pointing to a structural improvement in recent years. We use a taxonomy on digital intensity by industry which was recently developed by the Organisation for Economic Co-operation and Development (OECD) (Calvino et al., 2018), showing that the most digital-intensive industries have experienced a relatively strong performance in terms of labor productivity growth since 2007 and especially since 2013.

In Section 4 of the paper, we discuss the connection between labor and skills in the digital economy, which we believe provides the key to a productivity revival. We developed a new metric on innovation competencies by occupation on the basis of data from the O\*Net database on occupation-specific descriptors in the United States (Hao et al., 2018). When applied to the United Kingdom, we find that innovation competencies point at stronger productivity effects by industry.

In Section 5 we focus on how productivity has been behaving in the short-term during the COVID-19 recession. In particular, we address the potential trade-offs between traditional pro-cyclical recovery effects and scarring effects the recession leaves, especially on the labor market. We argue that increased adoption and usage of digital technologies during the COVID-19 crisis may create a positive productivity effect. In the final section, Section 6, we will review our hypothesis that a productivity revival could be imminent in the light of the recovery from the COVID-19 crisis. In order **not to miss** this **opportunity** again, as happened a decade ago, we argue that a coordinated effort from business and policy is needed, and has to be delivered in such a way that the gains from productivity will be more **widespread** and such that those who provide the resources for growth are incentivised to deliver them in an efficient way.

2. The productivity paradox of the New Digital Economy

It is well known that General Purpose Technologies (GPTs), defined as new methods of producing and inventing new goods and services which are important enough to have a long-term aggregate impact on the economy, can take a significant amount of time to translate to faster **productivity** growth at the **aggregate level** of the economy. This is inherent to the three critical characteristics of a GPT as identified by Bresnahan and Trajtenberg (1995).2

1. Pervasiveness –The GPT should spread to most sectors.

2. Improvement –The GPT should get better over time and, hence, should keep lowering the costs of its users.

3. Innovation spawning –The GPT should make it easier to invent and produce new products or processes.

Historical analysis has focussed on productivity trends in previous technology phases (Bakker et al., 2019; Crafts, 2004). Recent literature has shown that the information and communication technology (ICT) revolution of the past 50 years can be characterised as a GPT and doesn’t pale with previous GPTs such as steam technology, electricity and the combustion engine. For example, Hempell (2005) concludes that ‘investment in information and communication technologies (ICT) are **closely linked** to **complementary** innovations and are most **productive** in firms with experience from earlier innovations’. In a more recent analysis of the evolution of the Internet, Simcoe (2015) argues that the modularity of the internet has prevented a **fall** in **return** to **investments** in **innovation** by ‘facilitating low-cost **adaptation** of a shared general-purpose technology to the demands of heterogeneous applications’. In a review of the data, Liao et al. (2016) conclude that:

‘...ICT investment does **contribute** to **productivity** but not in the usual manner –we find a positive (but lagged) ICT effect on technological progress. We argue that for a positive ICT role on growth to actually take place, a period of negative relationship between productivity and ICT investment together with ICT-using sectors’ capacity to learn from the embodied new technology was crucial. In addition, it took a learning period with appropriate complementary co-inventions for the new ICT-capital to become effective and its gains to be realised. Our findings provide **solid**, further **empirical evidence** to support ICT as a general purpose technology’.

**Growth solves nuclear war.**

**Henricksen 17**, \*Thomas H., emeritus senior fellow at the Hoover Institution; (March 23rd, 2017, “Post-American World Order,” Hoover Institution, <http://www.hoover.org/research/post-american-world-order>)

What Is To Be Done?

The first marching order is to dodge any kind of perpetual war of the sort that George Orwell outlined in  “1984,” which engulfed the three super states of Eastasia, Eurasia, and Oceania, and made possible the totalitarian Big Brother regime. A long-running Cold War-type confrontation would almost certainly take another form than the one that ran from 1945 until the downfall of the Soviet Union.

What prescriptions can be offered in the face of the escalating competition among the three global powers? First, by staying militarily and **economically strong**, the United States will have the resources to deter its peers’ **hawkish behavior** that might otherwise trigger a **major conflict**. Judging by the history of the Cold War, the coming strategic **chess match** with Russia and China will prove **tense** and **demanding**—since all the countries boast **nuclear arms** and long-range ballistic missiles. Next, the United States should widen and sustain willing coalitions of partners, something at which America excels, and at which China and Russia fail conspicuously.

There can be **little room** for **error** in **fraught crises** among **nuclear-weaponized** and hostile powers. Short- and long-term standoffs are likely, as they were during the Cold War. Thus, the playbook, in part, involves a **waiting game** in which each power looks to its rivals to suffer grievous internal problems which could entail a **collapse**, as happened to the Soviet Union.

Some Chinese and Russian experts predict grave domestic problems for each other. They also entertain **similar** thoughts about the United States, which they view as terminally decadent and catastrophically polarized over politics, ethnicity, and the future direction of the country. So, the brewing three-way struggle also involves a **systemic contest**, which will test the competitors’ **economic** and **political institutions**.

At this juncture, the world is entering a standoff among the three great and several not-so-great powers. Averting war, while defending our interests, will prove a challenge, calling for deft policy, political endurance, and **economic growth**, as well as sufficient military force to **keep at bay** aggressive states or **prevail** over them if ever a war breaks out.

**Emergence of smart cities depends on IoT applications of 5G interoperability standards---absent FRAND, excessive royalties will undermine sustainable development.**

**Schwartz 18**, \*Matt Schwartz, Privacy Fellowship Coordinator at ACT, App Association; (March 2nd, 2018, “It’s Smart to be FRANDly: How the FRAND Commitment Will Determine the Future of Smart Cities”, https://actonline.org/2018/03/02/its-smart-to-be-frandly-how-the-frand-commitment-will-determine-the-future-of-smart-cities/)

In December, we [outlined](https://actonline.org/2017/12/18/smart-cities-connecting-your-community-through-technology/%5d) the emergence of **Smart Cities** – cities that harness technological **innovations** like internet of things (**IoT**) devices and data analytics to improve essential infrastructure in growing urban centers. The technological foundation of Smart Cities aims to improve public safety, better allocate resources, and meet the needs of citizens more quickly.

A central element to Smart Cities is the comprehensive network of sensors and devices implemented within buildings, roads, traffic signs, and parking meters that allows them to interact with public, and potentially private-owned, infrastructure. These sensors will “speak” to one another, communicating information about energy usage, traffic density, or other elements of city management that have traditionally either been analyzed separately or not tracked at all. The potential of Smart Cities allows data to flow from previously disconnected branches of the city and be processed in real-time, unlocking previously unknown insights.

The powerful **interoperability** of Smart Cities will rely heavily on **standardized technologies** developed in organizations like the IEEE, which is responsible for standardizing the wi-fi technology we use every day. Standardized technologies often include standard-essential patents (**SEPs**), which, like their name suggests, are patents declared essential to an industry standard by a standards-setting organization. In simple terms, one cannot implement the standardized technology without using the patent.

Like regular patents, the users of SEPs must pay royalties or **licensing fees** to the patent owner before they may use it. For example, if a manufacturing company wants to make an IoT device interoperable with a 5G network, the manufacturer must pay a licensing fee to the owner of the SEP that is essential to the 5G standard. SEPs play a **vital role** in the new innovations we enjoy and have come to expect, and because of the value of these patents, SEP holders have the ability to demand **high license fees** from those who wish to implement the standard. To offset this **competition issue**, many SEP holders **voluntarily** agree to license their SEPs to any willing licensee under fair, reasonable, and non-discriminatory (**FRAND**) terms.

While wi-fi and LTE are standards that will be vital to Smart City deployment, countless new standardized technologies are being developed that will be integral to any fully-operational Smart City. With **reasonable access** to SEPs, assured by the FRAND commitment, innovators can enjoy the **legal** and **business certainty** they need to **compete**. While the meaning of the FRAND commitment continues to be refined – as evidenced by the development of SEP best practices recently launched by the App Association in Europe – its foundations are well-established.

But what happens when SEP holders do not abide by the FRAND licensing commitment, or simply refuse to license at all? Sadly, small and medium-sized companies would be **forced** to accept **untenable** licensing terms, but more realistically, they would be **priced out** of using the standard **altogether**. As a result, it would impose a **barrier** to **innovation** that would result in **fewer products** offered to consumers or cities eager to implement **IoT technologies**. For example, many hope the rise of autonomous vehicles will be seamlessly integrated into the Smart City network. But how beneficial would it be if only some autonomous vehicle brands are able to license the technology needed to communicate with traffic lights, simply because of the market power of a chipmaker? The FRAND commitment is an important backstop to that unfortunate possibility.

It is vital for SEP holders to honor FRAND licensing terms, if not for small and medium-sized innovators, then for the sustainability of future Smart Cities. FRAND creates a platform for innovation, providing a floor on which companies can stand, innovate, and compete. If the foundation of the FRAND commitment is reneged, American innovators pay a **steep price** – not only do they lose a **key component** of product **development** and **market entry**, but they are also left with years of expensive negotiations and litigation if they choose to challenge the licensing practice. What’s more, the **confidence** developed in the open standards development system is **shaken**, and Smart Cities have fewer choices in IoT solutions for their future.

To achieve the promise of Smart Cities, a balanced standards ecosystem is essential. We must allow small and medium-sized developers to **leverage industry standards** for innovation and prevent cost-prohibitive royalty structures and negotiating practices that are **detrimental** to **competition**, while also ensuring that SEP owners can protect their intellectual property and be fairly compensated for its use. The FRAND commitment continues to be the **best framework** to achieve this balance, and **adherence** to its **principles** will determine the **future** and **success** of **Smart Cities**.

**Climate change is anthropogenic and causes extinction---5G-enabled smart cities are critical for mitigation and adaptation.**

**Huseien 21**, \*Ghasan Fahim Huseien is a research fellow at Department of Building, School of Design and Environment, National University of Singapore, Singapore; Dr. Kwok Wei Shah is presently an assistant professor and deputy program director with the Department of Building, School of Design and Environment, National University of Singapore, Singapore; (August 23rd, 2021, “Potential Applications of 5G Network Technology for Climate Change Control: A Scoping Review of Singapore”, https://www.mdpi.com/2071-1050/13/17/9720)

Currently, the **entire planet** is at risk due to continual **climate change** [1–3]. The recorded increase in average temperature across the world in the past hundred years, and the associated changes attributed to this, are known as global warming. Many scientists are convinced by the published evidence that this change is **anthropogenic** and resulted from the **elevated emission levels** of global greenhouse gases (GHGs) [4,5]. Gases such as water vapor, carbon dioxide, methane, nitrous oxide, and ozone are responsible for the absorption and emission of thermal radiation. These changes in the relative quantities of the GHGs induce a proportional change in the amount of preserved solar energy. Presently, the accepted indicator for global warming is the sustained rise in the mean temperature worldwide. This definition is designed to account for the fact that there may be some localized exceptions to this rise. For example, there may be cooling experienced in a region while the global temperature may increase altogether, hence the need for average temperature. A key concern with the GHGs trapping of more heat in the atmosphere is that it affects both climate and short scale weather patterns. Consequently, it results in **greater numbers** of **adverse weather events** such as storms, heat waves, cold snaps, droughts, and fires [6]. **Climate-related risks** to health, livelihoods, food security, water supply, human safety, and economic growth are projected to **increase** with global warming of 1.5 ◦C [7] and further increase further at 2 ◦C, as shown in Figure 1. In addition, the risks to global aggregated economic growth due to the climate change impacts are projected to be lower at 1.5 ◦C than at 2 ◦C by the end of this century.

Carbon dioxide has the most **substantial effect** on global warming [8]. Although it was once assumed to have an ~100 year lifespan in the atmosphere, careful studies revealed that the situation is far worse, with three-quarters of the gas expected to remain for a time in the region of up to ~1000 years, with the remainder lasting for an indefinite period of time [9]. It was indicated that the present impacts of humanity on the atmosphere can certainly cause a long term problem [10]. Carbon dioxide is released when oil, coal, and other fossil fuels are burnt for the energy we use to power our homes, cars, and smartphones. By **lessening** its **usage**, we can **curb** our own **contribution** to climate change while saving money. The first challenge is eliminating the burning of coal, oil, and, eventually, natural gas. Oil is the lubricant of the global economy as it is hidden inside such ubiquitous items as plastic and corn, fundamental to the transportation of both consumers and goods. Coal is the substrate, supplying roughly half of the electricity worldwide, a percentage that is likely to grow according to the International Energy Agency (IEA). In fact, buildings contribute up to 43% of all the greenhouse gas emissions worldwide [11], even though investing in thicker insulation and other cost-effective as well as temperature-regulating strategies can save money in the long run. Investment in **new infrastructures**, or radical **upgradation** of the existing highways and transmission lines, may help to **reduce** greenhouse gas **emissions**, yielding economic growth in the developing countries.

Nations across the globe have kept very **high targets** to reducing their GHG discharges [12,13]. In order to meet these goals, **considerable reductions** in city energy usage is required. At a global scale, urban communities represent over half (55%) of the population, which is predicted to reach **68%** by the middle of this century [14]. Urban areas claim ownership of the **highest levels** of energy use, gas emission, and also the largest local economy. As such, it is **crucial** for urban areas to **reduce** their **consumption** and utilize **renewable sources** wherever available to reduce their gas discharge levels. Smart cities often utilize **digital sensors** to measure and transmit data about the levels of GHGs in the city at that moment, as a means of tackling them [15]. The **efficacy** of such a system is thus **reliant** on the network used to collate and analyze the data collected as an extant network. The mobile telecommunications networks offer a **convenient solution** to this desire, as their pre-existence has the clear benefit of reducing costs compared to the design and implementation of a novel system. It is recognized that smart cities will certainly act as the key players meeting these ambitious targets [16,17]. In this study, we focused primarily on the potential applications of 5G network technology to control climate change in Singapore. In addition, a **clear overview** of the **sustainability benefits** of introducing **5G** technology **compatible** smart cities, buildings, and farms in all aspects of urbanization is provided. Herein, the main purpose is to tackle the **negative outcomes** associated with **anthropogenic climate change**, with a particular focus on the contributions that are best made by the telecoms network operators.

Climate change is one of the most **challenging problems** that humanity has ever faced. Presently, hundreds of millions of lives, innumerable species, entire ecosystems, health, economy, and the **future habitability of this planet** are at risk. Fortunately, climate change is **solvable**, we just need to **wisely exploit** the **existing technologies** and **sciences**. Climate change mitigation is a pressing international need in which many management actions are required. The development of 5G technology has been largely driven by smart mobile devices and advanced communication technologies. It may thus serve as a **technical enabler** for a whole new range of business opportunities, energy, and facilities management, together with industrial applications. Moreover, it may enable different devices to work together seamlessly. Definitely, the 5G cellular network technology is expected to **revolutionize** the **global industries** with **profound effects** on the savings of energy, waste generation and recycling, and water resources management, thus **reducing** the **climate change impacts**.

**1AC — Cybersecurity**

**Advantage 2 is Cybersecurity —**

**Aggressive patent strategies create structural flaws in 5G standardization that imperils domestic cybersecurity---market competition reduces the incidence of vulnerability and severity of attacks.**

**Duan 20**, \*Charles Duan is a senior fellow and associate director of tech & innovation policy at the R Street Institute, where he focuses his research on intellectual property issues; (2020, “OF MONOPOLIES AND MONOCULTURES: THE INTERSECTION OF PATENTS AND NATIONAL SECURITY”, Santa Clara High Technology Law Journal, 36(4), 369-405. Retrieved from <https://www2.lib.ku.edu/login?url=https://www.proquest.com/scholarly-journals/monopolies-monocultures-intersection-patents/docview/2442966690/se-2?accountid=14556>)

III. COMPETITION AND CYBERSECURITY

In addition to the historical review done so far, another approach to understanding the relationship among patents, competition, and national security is to consider the role of **cybersecurity**. There is little doubt that computer system vulnerabilities that enable **hacking** and **spread** of **computer exploits** are a **threat** to the **nation’s defenses**, so better cybersecurity is a **key part** of national security strategy.155

**Strong competition** can thus **complement** national security by enhancing domestic cybersecurity, and **patent assertion** that **unduly weakens** competition **detracts** from cybersecurity.156 Competition promotes better cybersecurity in at least two ways. First, multiple studies show that competition encourages firms to improve their products on multiple vectors including cybersecurity. Second, competition avoids a situation that security experts call a “monoculture,” which increases vulnerability to severe cyberattacks. As former Secretary of Homeland Security Michael Chertoff wrote recently, “We need **competition** and **multiple providers**, not a potentially vulnerable technological monoculture,” to **guarantee** national security.157 Thus, cybersecurity provides a **useful lens** for understanding how **unfettered** patent assertion and **licensing** can **detract** from **national security**.

A. Cybersecurity as Competitive Value-Add

Competition enhances national security by **reducing** the **incidence** of technical **vulnerabilities**. That effect is **especially important** for security **sensitive systems** such as **mobile telecommunications**.

Intuitively, a **causal chain** from **competition** to **cybersecurity** makes logical sense. Computer security is a value-added benefit to consumers, so firms in competitive markets are likely to use security to gain an edge over their competitors.158 In monopolized markets, though, there may be less **external impetus** to **test products** for flaws, and the **monopolist** may **choose** to **focus less** on **security** and more on new product features or increased product quality.

Economic research confirms these hypotheses about competition leading to better cybersecurity. A 2009 empirical study of web browsers considered the impact of market concentration on the amount of time that vendors took to fix security vulnerabilities as they were discovered.159 The study found that the **presence** of more **competitors** correlated with **faster cybersecurity** response—a reduction of 8–10 days in response time per additional market rival.160 Similarly, business researchers in 2005 modeled incentives for firms to engage in sharing of cybersecurity information, and concluded that the “**inclination** to **share information** and **invest** in **security technologies** increases as the **degree** of **competitiveness** in an industry increases.”161 Another study found that, where two software firms are in competition, at least one will be willing to take on **some degree** of **risk** and **responsibility** for cybersecurity, whereas a monopoly software firm will **consistently fail** to accept such responsibility.162 To be sure, an unpublished study from 2017 found that some market concentration can make firms more responsive to cybersecurity issues, but only to a point: “being in a dominant position reduces the positive effect of having less competitors on the responsiveness of the vendor,” and indeed the “more dominant the firm is, the less rapid it is in releasing security patches.”163 This research confirms that competition is more conducive to cybersecurity.

It is not hard to see how this applies to emerging communication technologies markets. In the absence of competition, the above research suggests that device manufacturers, chip makers, and software developers will **lack incentives** to **respond** to **vulnerabilities**, to **share information** about cybersecurity practices and issues, and to **take responsibility** for security matters. Mobile phone chips have had their share of cybersecurity failures already.164 **The best way to flush out ongoing and future cybersecurity issues is to maintain competitive pressure at all levels of the supply chain.**

B. Vulnerabilities of “Monocultures”

A second reason why monopoly undermines cybersecurity is that monopoly leads to a “**monoculture**” of single-vendor products, opening the door to **massive** systemic **failure** in the case of a **cyberattack**. Computer researchers developed the theory of software monocultures in the early 2000s, in response to the regular phenomenon of computer viruses and other attacks spreading rapidly by exploiting flaws in the dominant operating system at the time, Microsoft Windows.165 Where a computer system such as Windows has a commanding share of users, a virus that **exploits** a **flaw** in that system can quickly **spread** to **infect** a whole **interconnected ecosystem**. An operating system monopoly thus enables fast and easy spread of cyberattacks, and better cybersecurity would be achieved through greater diversity in online systems.166 As one research group posited, “a network architecture that **supports** a collection of **heterogeneous network** elements for the same **functional capability** offers a **greater possibility** of **surviving** security **attacks** as compared to **homogeneous networks**.”167

There has been considerable study of the theory that computer monocultures are **naturally** more **vulnerable** to attacks.168 In one study, computer science researchers reviewed a catalog of 6,340 software vulnerabilities recorded in 2007, to compare whether comparable software would share the same flaws.169 Of the 2,627 vulnerabilities applicable to application software (as opposed to operating systems, web scripts, and other software components), only 29 (1.1%) applied to substitute products from different vendors but providing the same functionality.170 By contrast, different versions of a single software product were found to share vulnerabilities 84.7% of the time.171 Thus, software monocultures share **exploitable flaws** even when there is some **variation** in **versions** across the **monoculture**; by contrast, diversity in software is almost **guaranteed** to **prevent** a **single flaw** from **affecting** all **users**.

In the case of 5G and wireless mobile communications, a monoculture is an **especially concerning** possibility. To the extent that systems such as smart city sensors or communication networks are **widely deployed** in a monoculture fashion, a **widespread attack** could have **devastating** consequences, potentially blacking out a region and affecting essential services such as 911.172 A monoculture that is vulnerable to so-called “**rootkits**” or “**backdoors**”—maliciously installed software that enable **bad actors** to commandeer systems—could also enable **mass surveillance** or **spying** by private hackers or foreign governments.173 The presence of systems from **multiple vendors** would mitigate these possibilities.

The monoculture theory is not without critics, but a review of those criticisms shows them to be inapplicable to contemporary communication technologies. Some critics suggest that software diversity imposes **unwarranted costs** on firms who must **forego** economies of scale and devise seemingly duplicative yet different setups of computer systems.174 But those concerns **largely focus** on the situation where a **single firm** produces and manages heterogeneous systems, concerns that are **avoided** where **heterogeneity** arises **naturally** through **competition** between two **unrelated** firms. Critics also argue that technological measures can create “artificial diversity” through automated randomization of software code, so software engineers can purportedly solve monoculture issues and device users need not worry about the issue.175 But even these critics acknowledge that artificial diversity techniques are often **insufficient** because they must make **assumptions** about what **aspects** of the **technology** are **most vulnerable** to **attack**, and they **concede** that artificial diversity **cannot stop** attacks involving operation of **legitimate** software functions in **undesirable** ways (sending spam emails or deleting document files, for example).176

It is widely recognized that a monoculture is **unavoidable** in at least one respect: Most connected devices will need to **conform** to technical **standards**.177 5G, for example, is a technical standard developed by a private industry consortium called 3GPP.178 A **flaw** in any such standard would render **all mobile devices** implementing the standard **vulnerable** to an **identical attack**.179 Avoiding these sorts of **systemic flaws** in standards requires rigorous **development**, **analysis**, and **testing** of the standard in the development process, which in turn requires ensuring that **as many firms** as **possible**, especially firms that share basic American values, are **involved** in the **development** of those **standards**.180 Thus, the necessary **standardization** of **information** and **communication technologies** is perhaps the most **important reason** why a **competitive** communication technology **market** is **essential** to **cybersecurity** and national security.

**Insecure technical standards cause inevitable systemic grid collapse---extinction.**

**DeNardis 21**, \*Dr. Laura DeNardis, PhD in Science and Technology Studies from Virginia Tech, Dean of the School of Communication at American University, and Gordon M. Goldstein, Adjunct Senior Fellow at the Council on Foreign Relations, (March 1st, 2021, “The Real Lesson of the Texas Power Debacle”, Lawfare, 3/1/2021, https://www.lawfareblog.com/real-lesson-texas-power-debacle)

The infrastructure was essential, ubiquitous and providing basic functionality for everything in daily life from water to heat and transportation. And in an instant it was gone, plunging tens of thousands of residents into a life-threatening crisis. This is, of course, the narrative of the recent debacle in Texas, where a winter storm overwhelmed the state’s electrical grid and brought the state to a near-total blackout. But it should also be interpreted as a preemptive **warning** of what Americans will face from the next generation of the **internet** and the new realm of cybersecurity risk it will **dramatically** amplify.

Both forms of infrastructure—a state-run electrical grid and the **5G** and “**internet of things**” future to which we are rapidly hurtling—share three attributes. First, their construction reflects a lack of imagination about the danger that can quickly **coalesce** when seemingly remote threat scenarios become real. Second, compounding a lack of analytic imagination is an absence of preparedness. Third, for both the Texas electrical grid and the emerging internet, public policy protections are either meager or completely absent.

In planning for the resilience of its electrical grid, public officials in Texas **discounted** the potentially devastating disruption that could occur from **unpredictable** events—whether related to climate change or just a once-a-century anomaly. They also eschewed precautions other states take seriously by allowing for the interconnection of electrical grid supply chains across their borders, ostensibly because of their ideological rejection of federal regulatory oversight governing such arrangements.

As the United States builds out a new national **5G** cyber-physical communications network through private service providers, Americans similarly **discount** the **risks**—myriad in their diversity and severity—that are **orders** of **magnitude** more **significant** than what Texas confronted recently. More physical things than people are already connected. The super empowered internet of tomorrow, known among some in the field as the “internet of everything,” will exceed by **tens of billions** of devices the number of connections between individuals simply communicating via social media or digital screens.

This confronts policymakers with an imminent threat: A cyber outage is **no longer** about losing digital communications but about losing basic **societal functioning** and even **human life**. The failure of imagination is to think of the SolarWinds attack on U.S. federal agencies and tech companies as a **worst-case scenario**. The failure of imagination is to think of cybersecurity through a content-centric lens rather than as possible attacks on the material world. The emergence of internet-connected cardiac devices, digitally dependent cars, and internet-connected agriculture systems portend the stakes of a cyberattack to **health care**, economic and **social functioning**, and **food security.**

The United States should be prepared for, and certainly not be caught by surprise by, such cyberattacks. Yet, the internet of everything is notoriously **insecure**. Internet-connected physical objects are not necessarily upgradeable. Nor do they come with adequate default security and encryption. The 5G infrastructure that helps connect digital objects has been at the center of debates over Chinese espionage. Industrial cyber-physical **systems** are based on **technical standards** that have not been collaboratively vetted for **security** and **interoperability**. One of the most infamous cyberattacks—the so-called Mirai botnet that took down major media sites and corporations—hijacked these insecure objects in homes to carry out the assault. The United States is not yet prepared.

Finally, in the race to conceive and deploy effective public policy responses, the U.S. government as a whole is hardly more anticipatory or synthesized in its response to potential calamity than the state of Texas. The focus of U.S. cyber policy remains on information policy issues such as disinformation, manipulation and violent speech rather than securing the digital world that now powers our material day-to-day lives. The Biden administration confronts an enormous challenge in crafting a comprehensive strategy to the cybersecurity risks foreshadowed by the ruinous experience in Texas and its management of vital infrastructure. While the digital world has leapt from two-dimensional to three-dimensional space, cyber policy has not at all jumped from 2D to 3D.

This failure of imagination, preparedness and policy protection must not be America’s cyber future; the stakes are far **too high** and the costs are far **too great.** The Texas disaster is a potent illustration of what has always been true: Our digital society and economy are extremely vulnerable and grow more porous and subject to penetration day by day. As digital sensors and cyber control systems become further embedded in physical infrastructure like energy systems, agriculture and transportation, there is no longer a separation between security of the **“real” world** and security of the **online world**. They are **entangled** and increasingly **enmeshed**—and policy has yet to catch up to either envisioning or mitigating the looming threats the U.S. confronts.

If the energy grid cannot weather a winter storm, how can it be expected to withstand a major cyberattack? What other vital forms of national infrastructure—ranging from water, bridges, highways and roads, and ultimately our day-to-day financial system—are **comparably** at **risk**? As Texas dramatizes, it is neither **hyperbolic** nor **exaggerated** to assert that **our survival** could now depend on **securing** the inevitable **cyber-physical future** that is accelerating with **stunning rapidity**.

#### Cyberwar is increasingly likely---SolarWind emboldens hackers to undermine critical infrastructure and nuclear supply chains.

Bajema 21, \*Dr. Natasha Bajema is the Director of the [Converging Risks Lab at the Council on Strategic Risks](https://councilonstrategicrisks.org/programs/csw/dr-natasha-bajema/) and an IEEE Spectrum contributor. She has held long-term assignments at the National Defense University, in the U.S. Office of the Secretary of Defense, and at the U.S. Department of Energy’s National Nuclear Security Administration; (March 24th, 2021, “Today's Cyberattacks Foreshadow Wars to Come”, https://spectrum.ieee.org/riskfactor/aerospace/military/todays-cyberattacks-foreshadow-wars-to-come)

Cyberattacks are no longer just a matter of cybersecurity, they directly threaten a country’s national security. Cyberattacks alter the character of warfare—much like nuclear weapons once did, allowing adversaries to potentially cross enemy lines to harm large numbers of innocent civilians.

Today’s malicious actors can now seek to cause physical damage from remote locations through digital channels, wreaking devastation on a country at levels that previously would have required a kinetic attack.

On February 8, 2021, hackers breached the Bruce T. Haddock Water Treatment Plant in Oldsmar, Fla. using known software vulnerabilities in an attempt to poison the local water supply with sodium hydroxide—also known as lye. They accessed the plant through its industrial control system (ICS)—a system designed to allow for remote control and supervision of the plant. Taking over the plant’s controls, hackers increased parts of the chemical, used to [adjust the acidity and remove metals from drinking water](https://www.foxnews.com/politics/senate-intel-chairman-florida-water-plant-cyberattack), to one hundred times over the normal level. The system used an [old version of Windows, was accessible with a shared password, and had no firewall protection against intrusions](https://techgenix.com/florida-water-treatment-facility-cyberattack/). Thankfully, [a supervisor noticed the dangerous change in time whilst working remotely](https://www.govtech.com/em/safety/Cyberattack-on-Water-Treatment-Facility-Suggests-More-to-Come.html), averting a crisis that may have caused chemical burns and blindness among those exposed to the toxic chemical.

U.S. government officials have recently expressed concerns about similar vulnerabilities across water and energy sectors and other critical infrastructure including [health, emergency services, food and agriculture, and transportation systems](https://www.foxnews.com/politics/senate-intel-chairman-florida-water-plant-cyberattack). The cyberattack on the water plant occurred just a week before a major winter storm led to a widespread blackout and water crisis across Texas. [More than five million](https://time.com/5939633/texas-power-outage-blackouts/) went without power and running water for several days, illustrating the fragility of such interconnected infrastructure and the physical devastation that could be caused in the event of a cyberattack targeting the grid.

Critical infrastructure is not alone in its vulnerabilities to cyberattacks with physical implications—supply chains are also at risk. For at least a span of months (if not years), hackers have [exploited vulnerabilities](https://en.wikipedia.org/wiki/2020_United_States_federal_government_data_breach) in software from Microsoft, VMWare and the Texas-based company [SolarWinds](https://www.solarwinds.com/) to compromise data security in at least 200 organizations in the U.S. government and other agencies around the world.

Although the SolarWinds attack appears to be a [case of classic espionage by Russia](https://www.securityinfowatch.com/cybersecurity/article/21206223/more-questions-than-answers-as-solarwinds-breach-probe-expands) via the U.S. supply chain, there are aspects of the attack that also illustrate the potential for achieving physical effects via digital channels. As early as [March 2020](https://www.securityinfowatch.com/cybersecurity/article/21206223/more-questions-than-answers-as-solarwinds-breach-probe-expands), Russian hackers breached the Orion network management software designed by SolarWinds, a federal contractor, and planted malicious code likely intended to gain access to sensitive information. Evidence of malware was first detected [in December by a cybersecurity company](https://www.newsweek.com/colorado-representative-says-solarwinds-hack-could-cyber-equivalent-pearl-harbor-1555994) that also uses the Orion software. The impact of the SolarWinds cyberattack spanned [thousands of networks](https://www.securityinfowatch.com/cybersecurity/article/21206223/more-questions-than-answers-as-solarwinds-breach-probe-expands) at [nine federal agencies and 100 private sector companies](https://www.cyberscoop.com/solarwinds-cyber-espionage-russia-neuberger/), including the Department of Energy’s National Nuclear Security Administration (NNSA), which is responsible for overseeing the U.S. nuclear weapons stockpile.

Although NNSA claims there was no impact to classified systems, officials found [evidence of attempted intrusion](http://www.politico.com/news/2020/12/22/nuclear-weapons-agency-congress-hacking-450184) in unclassified systems—although, according to the NNSA Public Affairs office, the system in question was used for business purposes, not for transport of nuclear weapons and materials. The agency also detected attempts to gain access to servers at the Los Alamos National Laboratory—one of three nuclear weapons labs. [NNSA immediately disconnected the software from relevant networks](https://www.energy.gov/articles/doe-update-cyber-incident-related-solar-winds-compromise), removing the possibility for deleterious effects. While hackers were not likely targeting the transport of nuclear weapons, the [vulnerabilities of nuclear weapons](https://www.nap.edu/read/11538/chapter/6#112) [while en-route](https://www.osti.gov/servlets/purl/1409912) [between secure locations](https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1348_web.pdf) are well known.

The exact objectives for the SolarWinds cyberattack remain unclear, but the vast extent of its reach may demonstrate to U.S. adversaries the significant potential of cyberattacks for achieving physical ends, including the possibility of stealing nuclear weapons. However, the incident is not the first major one from which malicious actors have deduced such capabilities—[consider the lessons from the NotPetya attack in 2017](https://spectrum.ieee.org/tech-talk/computing/it/notpetya-latest-ransomware-is-a-warning-note-from-the-future). Russian hackers spread malicious code through a popular accounting software developed by a Ukrainian business across many countries in Europe, eventually infecting tens of thousands of computers around the world. In addition to rendering infected computers useless, the attack shut down the global operations of the Maersk shipping company and caused major traffic congestion on the roads near ports in the United States. It also slowed operations of Merck & Co, Inc., a major producer of drugs and vaccines in the U.S., [reducing production capacity for a short period of time](https://www.fiercepharma.com/manufacturing/merck-has-hardened-its-defenses-against-cyber-attacks-like-one-last-year-cost-it). Even a classic espionage or sabotage incident may carry significant potential for physical damage.

The [Biden administration has already issued guidance](https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/) for shoring up vulnerabilities in U.S. supply chains, but much more needs to be done to protect critical infrastructure and dissuade malicious actors from exploiting digital channels to achieve physical ends. In an era of hybrid and gray zone warfare, cyberattacks are attractive to nations seeking to undermine their adversaries due to challenges of attribution and the associated benefit of deniability. In the future, these nations may also come to see cyberattacks with physical effects as a new form of warfare—a Trojan horse in the form of their adversary’s own infrastructure or supply chains. In so doing, they can cross enemy lines and cause damage and destruction without defeating any military forces.

**Actors have the means and motivations to strike critical infrastructure.**

**Wintch 21**, \*Timothy M. Wintch, an active-duty Major in the United States Air Force. He is currently a graduate student at the Oettinger School of Science & Technology Intelligence, National Intelligence University, in Bethesda, Maryland. Mr. Wintch has over 11 years of experience in command-and-control operations as an Air Battle Manager. He holds a Bachelor of Arts in Politics from the University of California, Santa Cruz, and a Master of Arts in Military Studies from American Military University. (April 20th, 2021, “PERSPECTIVE: Cyber and Physical Threats to the U.S. Power Grid and Keeping the Lights on”, https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/)

Among critical infrastructure sectors in the U.S., energy is perhaps the most crucial of the 16 sectors defined by the Department of Homeland Security. This sector is **so vital** because it provides the energy necessary to run **every other** critical infrastructure sector. However, the U.S. power grid, the backbone of the energy sector, is built upon an aging skeleton that is becoming increasingly **vulnerable** every day. Whether from terrorists or nation-states like Russia and China, the power grid is susceptible to not just physical attacks, but also to **cyber** intrusion as well. However, much of this threat can be mitigated if the U.S. takes the appropriate steps to safeguard the power grid and avoid a potential catastrophe in the future.

Since Sept. 11, 2001, terrorism on U.S. soil has been at the forefront of American consciousness. Critical infrastructure provides an **appealing** target because of the disproportionally **large impact** even a **small attack** can have on the sectors. In particular, the power grid represents a particularly lucrative target, both in terms of the ease of access and the large impact it can make. The National Research Council stated that the U.S. power grid is “vulnerable to intelligent multi-site attacks by knowledgeable attackers intent on causing maximum physical damage to key components on a wide geographical scale.”[[1]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn1) Additionally, the physical security of transmission and distribution systems is difficult due to the **dispersed** nature of these key components, which in turn is advantageous to attackers as it reduces the likelihood of their capture.[[2]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn2) From 2002-2012, approximately 2,500 physical attacks occurred against transmission lines and towers worldwide and approximately 500 attacks against transformer substations.[[3]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn3) Terrorists have the **motivation** to attack the U.S. power grid but the very nature of the grid makes it highly vulnerable. The power grid is not only at risk from physical attacks, but also nation-state cyberattacks.

One nation that has shown both the **capability** and **intent** to use attacks against critical energy infrastructure is Russia, as demonstrated in their 2015 annexation of Crimea from Ukraine. A Russian cyber threat group known as Sandworm, which used its BlackEnergy malware, attacked Ukrainian computer systems that provide remote control of the Ukraine power grid.[[4]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn4) This attack, and another in 2016, each left the capital Kiev without power, prompting cyber experts to raise concern about the same malware already existing in NATO and the U.S. power grids.[[5]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn5) In any conflict between Russia and NATO, not only would similar cyberattacks pose a threat, but so would potential physical attacks severing fuel oil and natural gas lines to Western Europe. Russia has both the capability and intent to attack critical infrastructure, particularly power grids, during future conflicts in their “hybrid warfare” approach.

Another nation that has the capability to attack critical energy infrastructure is China, representing a threat to not just the U.S. energy infrastructure but also that of our allies whose support would be vital in a major conflict. A recent NATO report highlighted this threat from China’s Belt and Road Initiative, stating that “[China’s] foreign direct investment in strategic sectors [such as energy generation and distribution] …raises questions about whether access and control over such infrastructure can be maintained, particularly in crisis when it would be required to support the military.”[[6]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn6) Like Russia, China has been **active** with cyber **intrusions** in U.S. energy **infrastructure**. The Mission Support Center at Idaho National Laboratory characterized these as attacks as “multiple intrusions into US ICS/SCADA [Industrial Control Systems/Supervisory Control and Data Acquisition] and smart grid tools [that] may be aimed more at intellectual property theft and gathering intelligence to bolster their own infrastructure, but it is likely that they are also using these intrusions to develop capabilities to attack the [**bulk** electric system], as well.”[[7]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn7) China, therefore, has both the **capability** and **intent** to conduct cyber intrusions and attacks for myriad reasons.

Another arm of this threat is the reliance the U.S. energy industry has on imports from China, especially transformers. In early 2020, federal officials seized a transformer in the port of Houston that had been imported by the Jiangsu Huapeng Transformer Company before sending it to Sandia National Laboratory in Albuquerque. Sandia is contracted by the U.S. Department of Energy for mitigating national security threats.[[8]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn8) The Wall Street Journal reported that “Mike Howard, chief executive of the Electric Power Research Institute, a utility-funded technical organization, said that the diversion of a huge, expensive transformer is so unusual – in his experience, unprecedented – that it suggests officials had significant security concerns.”[[9]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/" \l "_ftn9) Previously destined for the Washington Area Power Administration’s Ault, Colo., substation, the transformer is believed to have been seized due to “backdoor” exploitable hardware emplaced by the Chinese prior to shipment.[[10]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/#_ftn10) Shortly after these events, President Trump issued Executive Order 13920, “[Securing the United States Bulk-Power System](https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-securing-united-states-bulk-power-system/),” essentially limiting the import of Chinese-built critical energy infrastructure components due to concerns about cybersecurity.[[11]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/#_ftn11) Interestingly, Jiangsu Huapeng “boasted that it supported 10 percent of New York City’s electricity load.”[[12]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/#_ftn12)

Franklin Kramer, the former Assistant Secretary of Defense for International Security Affairs, testified before a U.S. House of Representatives Energy and Commerce subcommittee during an energy and power hearing in 2011 and said that a “highly-coordinated and structured cyber, physical, or blended attack on the **bulk power** system, however, could result in long-term (**irreparable**) damage to key system components in multiple simultaneous or near-**simultaneous strikes**.” He added that “an outage could result with the potential to affect a wide geographic area and cause large population centers to lose power for **extended** periods.”[[13]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/#_ftn13) Even the inclusion of features such as smart grids to the overall grid structure poses new **vulnerabilities** through their connectivity. Kramer stated that “such connectivity means that the **distribution** system could be a **key vector** for a national security attack on the grid.”[[14]](https://www.hstoday.us/subject-matter-areas/infrastructure-security/perspective-cyber-and-physical-threats-to-the-u-s-power-grid-and-keeping-the-lights-on/#_ftn14)

**Those attacks cause accidental nuclear escalation.**

**Klare 19**, \*Michael T. Klare is a professor emeritus of peace and world security studies at Hampshire College and senior visiting fellow at the Arms Control Association; (November 19th, “Cyber Battles, Nuclear Outcomes? Dangerous New Pathways to Escalation”, https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation)

Yet another pathway to escalation could arise from a cascading series of **cyberstrikes** and **counterstrikes** against **vital national infrastructure** rather than on military targets. All major powers, along with Iran and North Korea, have developed and deployed cyberweapons designed to disrupt and destroy major elements of an adversary’s key **economic systems**, such as **power grids**, **financial systems**, and **transportation networks**. As noted, Russia has **infiltrated** the U.S. **electrical grid**, and it is widely believed that the United States has done the same in Russia.[12](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote12) The Pentagon has also devised a plan known as “Nitro Zeus,” intended to immobilize the entire Iranian economy and so force it to capitulate to U.S. demands or, if that approach failed, to pave the way for a crippling air and missile attack.[13](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote12)

The danger here is that **economic attacks** of this sort, if undertaken during a period of tension and crisis, could lead to an **escalating series** of **tit-for-tat attacks** against ever more **vital elements** of an adversary’s critical infrastructure, producing **widespread chaos** and **harm** and eventually leading one side to initiate **kinetic attacks** on **critical** military **targets**, risking the **slippery slope** to **nuclear conflict**. For example, a Russian cyberattack on the U.S. power grid could trigger U.S. attacks on Russian energy and financial systems, causing widespread disorder in both countries and generating an impulse for even more devastating attacks. At some point, such attacks “could lead to major conflict and possibly nuclear war.”[14](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote14)

These are by no means the only pathways to escalation resulting from the offensive use of cyberweapons. Others include efforts by **third parties**, such as **proxy states** or **terrorist organizations**, to provoke a global nuclear crisis by causing **early-warning systems** to generate **false readings** (“spoofing”) of missile launches. Yet, they do provide a **clear indication** of the **severity** of the **threat**. As states’ reliance on cyberspace grows and cyberweapons become more powerful, the **dangers** of **unintended** or **accidental escalation** can only grow more **severe**.

**Cyber-compromised NC3 causes nuclear war.**

**Klare 19**, \*Michael T. Klare is a professor emeritus of peace and world security studies at Hampshire College and senior visiting fellow at the Arms Control Association; (November 19th, “Cyber Battles, Nuclear Outcomes? Dangerous New Pathways to Escalation”, <https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation>)

The Nuclear-Cyber Connection

These links exist because the NC3 systems of the United States and other nuclear-armed states are **heavily dependent** on **computers** and other **digital processors** for virtually **every aspect** of their **operation** and because those systems are **highly vulnerable** to cyberattack. Every nuclear force is composed, most basically, of weapons, early-warning radars, launch facilities, and the top officials, usually presidents or prime ministers, empowered to initiate a nuclear exchange. Connecting them all, however, is an extended network of **communications** and **data-processing** systems, all reliant on **cyberspace**. Warning systems, ground- and space-based, must constantly watch for and analyze possible enemy missile launches. Data on actual threats must rapidly be **communicated** to decision-makers, who must then weigh possible responses and **communicate** chosen outcomes to launch facilities, which in turn must provide attack vectors to delivery systems. All of this involves **operations** in **cyberspace**, and it is in this domain that great power rivals seek **vulnerabilities** to exploit in a constant struggle for advantage.

The use of cyberspace to gain an advantage over adversaries takes many forms and is not always aimed at nuclear systems. China has been accused of engaging in widespread **cyberespionage** to steal technical secrets from U.S. firms for economic and military advantages. Russia has been accused, most extensively in the Robert Mueller report, of exploiting cyberspace to **interfere** in the 2016 U.S. presidential election. Nonstate actors, including terrorist groups such as al Qaeda and the Islamic State group, have used the internet for **recruiting** combatants and spreading fear. Criminal groups, including some thought to be allied with state actors, such as North Korea, have used cyberspace to **extort money** from banks, municipalities, and individuals.[4](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote04) Attacks such as these occupy most of the time and attention of civilian and military cybersecurity organizations that attempt to thwart such attacks. Yet for those who worry about strategic stability and the risks of nuclear escalation, it is the threat of cyberattacks on NC3 systems that provokes the greatest concern.

This concern stems from the fact that, despite the immense effort devoted to protecting NC3 systems from cyberattack, no enterprise that relies so extensively on computers and cyberspace can be made 100 percent invulnerable to attack. This is so because such systems employ many devices and operating systems of various origins and vintages, most incorporating numerous software updates and “patches” over time, offering multiple vectors for attack. Electronic components can also be modified by hostile actors during production, transit, or insertion; and the **whole system** itself is **dependent** to a **considerable degree** on the **electrical grid**, which itself is **vulnerable** to cyberattack and is far **less protected**. Experienced “**cyberwarriors**” of every major power have been working for years to probe for **weaknesses** in these systems and in many cases have devised cyberweapons, typically, malicious software (**malware**) and computer viruses, to exploit those weaknesses for military advantage.[5](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote05)

Although activity in cyberspace is much more difficult to detect and track than conventional military operations, enough information has become public to indicate that the major **nuclear powers**, notably China, Russia, and the United States, along with such secondary powers as Iran and North Korea, have established **extensive** cyberwarfare capabilities and engage in **offensive cyberoperations** on a **regular basis**, often aimed at **critical** military **infrastructure**. “Cyberspace is a contested environment where we are in constant contact with adversaries,” General Paul M. Nakasone, commander of the U.S. Cyber Command (Cybercom), told the Senate Armed Services Committee in February 2019. “We see near-peer competitors [China and Russia] conducting sustained campaigns below the level of armed conflict to erode American strength and gain strategic advantage.”

Although eager to speak of adversary threats to U.S. interests, Nakasone was noticeably but not surprisingly reluctant to say much about U.S. offensive operations in cyberspace. He acknowledged, however, that Cybercom took such action to disrupt possible Russian interference in the 2018 midterm elections. “We created a persistent presence in cyberspace to monitor adversary actions and crafted tools and tactics to frustrate their efforts,” he testified in February. According to press accounts, this included a cyberattack aimed at paralyzing the Internet Research Agency, a “troll farm” in St. Petersburg said to have been deeply involved in generating disruptive propaganda during the 2016 presidential elections.[6](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote06)

Other press investigations have disclosed two other offensive operations undertaken by the United States. One called “Olympic Games” was intended to disrupt Iran’s drive to increase its uranium-enrichment capacity by sabotaging the centrifuges used in the process by infecting them with the so-called Stuxnet virus. Another left of launch effort was intended to cause malfunctions in North Korean missile tests.[7](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote07) Although not aimed at either of the U.S. principal nuclear adversaries, those two attacks demonstrated a willingness and capacity to conduct cyberattacks on the nuclear infrastructure of other states.

Efforts by **strategic rivals of** the United States to **infiltrate** and eventually **degrade** U.S. **nuclear infrastructure** are far **less documented** but thought to be **no less prevalent**. Russia, for example, is believed to have planted **malware** in the U.S. electrical utility grid, possibly with the intent of **cutting off** the **flow** of **electricity** to critical **NC3 facilities** in the event of a major crisis.[8](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote08) Indeed, every major power, including the United States, is believed to have **crafted cyberweapons** aimed at critical **NC3 components** and to have implanted malware in enemy systems for potential use in some future confrontation.

Pathways to Escalation

Knowing that the NC3 systems of the major powers are constantly being probed for weaknesses and probably infested with malware designed to be activated in a crisis, what does this say about the risks of escalation from a nonkinetic battle, that is, one fought without traditional weaponry, to a kinetic one, at first using conventional weapons and then, potentially, nuclear ones? None of this can be predicted in advance, but those analysts who have studied the subject worry about the emergence of dangerous new pathways for escalation. Indeed, several such scenarios have been identified.[9](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote09)

The first and possibly most **dangerous path** to **escalation** would arise from the **early use** of **cyberweapons** in a great power **crisis** to ~~paralyze~~ **undermine** the vital command, control, and communications capabilities of an adversary, many of which serve nuclear and conventional forces. In the “**fog of war**” that would naturally ensue from such an encounter, the recipient of such an attack might fear more punishing follow-up kinetic attacks, possibly including the use of nuclear weapons, and, **fearing** the **loss** of its own **arsenal**, **launch** its weapons **immediately**. This might occur, for example, in a confrontation between NATO and Russian forces in east and central Europe or between U.S. and Chinese forces in the Asia-Pacific region.

Speaking of a possible confrontation in Europe, for example, James N. Miller Jr. and Richard Fontaine wrote that “both sides would have **overwhelming incentives** to go **early** with **offensive** cyber and counter-space **capabilities** to **negate** the other side’s military capabilities or **advantages**.” If these early attacks succeeded, “it could result in huge **military** and **coercive advantage** for the attacker.” This might induce the recipient of such attacks to back down, affording its rival a major victory at very low cost. Alternatively, however, the recipient might view the attacks on its critical command, control, and communications infrastructure as the **prelude** to a **full-scale attack** aimed at **neutralizing** its **nuclear capabilities** and choose to strike first. “It is worth considering,” Miller and Fontaine concluded, “how even a very limited attack or incident could set both sides on a slippery slope to rapid escalation.”[10](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote10)

What makes the insertion of **latent malware** in an adversary’s NC3 systems so **dangerous** is that it may not even **need** to be **activated** to **increase** the **risk** of **nuclear escalation**. If a nuclear-armed state comes to believe that its critical systems are infested with enemy malware, its leaders might **not trust** the information provided by its early-warning systems in a crisis and might **misconstrue** the **nature** of an **enemy attack**, leading them to **overreact** and possibly **launch** their **nuclear weapons** out of **fear** they are at **risk** of a **preemptive strike**.

“The **uncertainty** caused by the unique character of a cyber threat could **jeopardize** the **credibility** of the **nuclear deterrent** and **undermine strategic stability** in ways that advances in nuclear and conventional weapons do not,” Page O. Stoutland and Samantha Pitts-Kiefer wrote in 2018 paper for the Nuclear Threat Initiative. “[T]he introduction of a **flaw** or **malicious code** into nuclear weapons through the **supply chain** that **compromises** the **effectiveness** of those **weapons** could lead to a **lack** of **confidence** in the **nuclear deterrent**,” undermining strategic stability.[11](https://www.armscontrol.org/act/2019-11/features/cyber-battles-nuclear-outcomes-dangerous-new-pathways-escalation#endnote11) Without confidence in the reliability of its nuclear weapons infrastructure, a nuclear-armed state may misinterpret confusing signals from its early-warning systems and, fearing the worst, launch its own nuclear weapons rather than lose them to an enemy’s first strike. This makes the scenario proffered in the 2018 NPR report, of a nuclear response to an enemy cyberattack, that much more alarming.

**1AC — Plan**

**Plan: The United States federal judiciary should substantially increase prohibitions on private sector conduct that is more restrictive of competition than reasonably necessary to enable creation of information technology standards.**

**1AC — Solvency**

**Solvency —**

**The plan requires SSO’s to administer reasonable action to prohibit ex post opportunism---that strengthens FRAND effectiveness while enabling SEP holders to capture appropriate royalties---which is the best competition-innovation balance.**

**Melamed & Shapiro 18**, \*A. Douglas Melamed is Professor of the Practice of Law at Stanford Law School; \*Carl Shapiro is the Transamerica Professor of Business Strategy at the Haas School of Business at the University of California at Berkeley; (May 2018, “How Antitrust Law Can Make FRAND Commitments More Effective”, https://www-cdn.law.stanford.edu/wp-content/uploads/2018/05/How-Antitrust-Law-Can-Make-FRAND-Commitments-More-Effective.pdf)

3. Application of the Basic Legal Principles

The antitrust principle is **straightforward**: industry-wide collaboration through SSOs to establish procompetitive standards is **permitted** only if it is **no more restrictive** of competition than **reasonably necessary** to enable creation of the standards. When standard setting predictably creates technology **monopolies** that, if unrestrained, will enable **anticompetitive** ex post **opportunism** that would otherwise not occur, an SSO that **does not** take **effective** measures to prevent or minimize such ex post opportunism engages in conduct that is **more restrictive** of competition than necessary. In that case, the SSO and, in appropriate cases, its members, may well **violate Section 1** of the **Sherman Act**.

Under this principle, SSO procedures and FRAND rules should be **evaluated** based on whether they lead to **reasonable** SEP **royalties**, using the competitive ex ante licensing standard discussed above, which has been **adopted** by the courts in patent law. Put differently, FRAND rules should be evaluated based on their ability to prevent SEP holders from obtaining **more** than the **ex ante value** of their **technology** from implementers.

This limitation **would not** prevent a SEP holder from **proﬁting**, perhaps **greatly**, from participating in the SSO and having its patented technology included in the standard. The SEP holder **continues** to be **rewarded** for its technology because the inclusion of its technology in the standard can still **greatly increase** the volume of licensing opportunities available to the SEP holder.

Whether a particular set of FRAND rules are sufficiently effective in preventing ex post opportunism will depend on the particular circumstances. The procedural unfolding of the case will also depend upon the circumstances. As a general matter, the case would probably be structured as an ordinary **Rule of Reason** case.82

First, the plaintiff would have to demonstrate **harm** to **competition** as a result of the collaboration of the SSO’s members, many of which compete with one another. In this case, the harm to competition would stem from the ability of the SEP holder to exercise **monopoly** power by obtaining royalties in **excess** of the **competitive**, ex ante level. The decision to include patented technologies in the standard would be the allegedly **unlawful** agreement. Notably, the court **need not** determine what a FRAND royalty is; it would **suffice** to **determine** that **market power** has been **created** or **exercised**, and that existing SSO rules and policies were **not adequate** to prevent the competitive harm. The defendant, which could be the SSO or perhaps one or more SSO members, would win at this point if the plaintiff failed to show harm to competition. If might fail if the standard faces substantial competition and the court concludes that the SEP holder therefore does not have market power or if the SSO’s rules and policies are found to be effective in preventing ex post opportunism, even if the plaintiff or even the court thinks that other rules and policies would be preferable.

Second, if the plaintiff makes the requisite showing of harm to competition, the **defendant(s)** would then have to show some **procompetitive justiﬁcation**— in this case, the **beneﬁts** of the standard. These two initial steps should be straightforward.

Third, if as is likely the defendant is able to show a procompetitive justiﬁcation, the plaintiff would have to show that the SSO could have used available, reasonable **alternatives** to realize the **efficiency beneﬁts** with less or **none** of the competitive **harms**. The plaintiff might identify reasonable **alternatives** that would have led to a **different** standard, based on including **unpatented** technology in the standard or perhaps involving **fewer SEPs** or **fewer owners** of SEPs, which would be **less subject** to patent holdup. More likely, the plaintiff could suggest alternative SSO rules that would not change the standard, but would **reduce** the **likelihood** or extent of ex post **opportunism**. For example, the plaintiff might suggest more rigorous FRAND-type rules, such as rules that set forth more precise principles on which FRAND royalties are to be determined and the circumstances under which SEP holders might seek injunctions.

Fourth, the burden would then shift to the defendant(s) to show that the beneﬁts of the standard **could not** have been **realized** if the SSO had adopted any of the proffered **alternatives** or that those alternatives were unrealistic.83 The plaintiff would be entitled to judgment if the court concludes that those beneﬁts could have been realized with less competitive harm if the SSO had adopted the standard with different IPR rules or policies.

Our overall sense, based on experience and the empirical literature, is that the extant FRAND rules are generally useful, but tend to be **inadequate** because they are **imprecise** and leave **unresolved** such critical issues as (a) the meaning of a **reasonable** royalty, even conceptually; (b) the meaning of “**non-discriminatory**;” (c) to whom licenses must be offered; and (d) under what circumstances may a SEP holder obtain an injunction.84 These **imprecise** FRAND commitments are therefore **not sufficient** to adequately prevent ex post opportunism. The recent revisions to IEEE’s FRAND policy represent a signiﬁcant step in the right direction, but even this advance leaves important questions **unanswered**.85 If FRAND rules are inadequate in these ways, litigation involving extant FRAND rules would likely be resolved only at the ﬁnal, fourth step. The defendant would be able to **demonstrate** the **beneﬁts** created by the standard; the plaintiff would be able to demonstrate the **creation** of **market power** and that other reasonable and practical rules or policies would **ameliorate** the problem. The case would thus turn on whether the defendant is able to demonstrate that signiﬁcant beneﬁts associated with standardization could not have been realized if the SSO had adopted those other rules or policies.

The court would have **available** a **variety** of **possible remedies** if the plaintiff prevails. Implementers that paid supracompetitive royalties or were unlawfully excluded in whole or in part from product markets as a result of the inadequate FRAND policies would be **entitled** to **damages** and, in some cases, to **treble damages**.86 If the unlawful SSO conduct is regarded as the **collective action** of the SSO and its members, which is likely to be the case in most instances, SSO members would be **jointly** and **severally liable** for the damages. Forward-looking injunctive relief aimed at restoring competition would need to be fashioned to the requirements of the individual case. For example, a court could order the SSO to adopt a new rule or policy proposed by the plaintiff. If the court is reluctant to take on that governance role, it might give the SSO a period of time—maybe ninety days—to develop a rule, subject to the court’s ultimate approval, which would adequately ameliorate the competitive problem created by the SSO. Alternatively or in addition, the court might order the parties to attempt to **negotiate** a **rule** or policy on which they can agree. And, depending on the circumstances, the court might order SEP holders, including at least those that were defendants in the case, to comply with the new SSO rules and policies.

**Threatening antitrust liability lures SSO’s into adopting best practices.**

**Lemley & Shapiro 13**, \*Mark Lemley is the William H. Neukom Professor at Stanford Law School and a partner at Durie Tangri LLP; \*Carl Shapiro is the Transamerica Professor of Business Strategy at the Haas School of Business, University of California at Berkeley and a Senior Consultant at Charles River Associates; (2013, “A SIMPLE APPROACH TO SETTING REASONABLE ROYALTIES FOR STANDARD-ESSENTIAL PATENTS”, (https://faculty.haas.berkeley.edu/shapiro/frand.pdf)

Under our approach, many of these issues should become moot, since the patentee cannot obtain an injunction (or transfer the patent to someone who can) against a willing licensee, and since competitors are not involved in jointly setting the reasonable royalty rate. If SSOs set clear, reasonable rules following the best practices we recommend, and parties follow those rules, there should be **little** or **no need** for **antitrust** to **intervene**. Indeed, even the risk of non-disclosure of a patent is lessened, since the patentee has committed to license its essential patents whether or not it discloses them. For the most part, the rules we have described are **self-executing**, meaning that even if a party tries to break the rules set by the SSO there still may be no need for antitrust to intervene. Thus, we suggest that **parties** who **abide** by these **procedures**—patentees, implementers, and the SSOs themselves—should be **immune** from **antitrust liability** for activities that merely follow those rules.107 They have entered into an arrangement that is **on balance good** for **competition**, one that allows patentees to receive **reasonable royalties** but **prevents holdup** and **reduces** the risk of **monopolization** by **trickery**.

The fact that antitrust remains a last resort available when SSOs don’t follow best practices may have two practical benefits, however. First, under our approach the **promise** of **avoiding** the risk of **antitrust liability** will be a **powerful incentive** for both SSOs and patent owners to **adopt** the **best practices** we propose. Second, the risk of antitrust liability may be relevant when an individual patentee wants to adopt best practices but the SSO governing the standard has not yet done so. We propose that a patentee that unilaterally commits to the FRAND procedures we describe here should be immune from antitrust liability for following these procedures.108 A patentee’s unilateral binding commitment to arbitration could be enforced whether or not it was elicited by an SSO. Thus, just as the prospect of antitrust immunity might **lure SSOs** to **adopt best practices**, it might also lure **patentees** to **implement** those **practices** even if the SSO has not done so. Given the large number of standard-essential patents based on preexisting standards,109 and given that SSOs tend to update their IP rules rather slowly,110 this is **not** a **small matter**.

**Only antitrust enforcement creates a consumer-action feature that counterbalances SSO’s conspiratorial incentives---private action fails.**

**Melamed & Shapiro 18**, \*A. Douglas Melamed is Professor of the Practice of Law at Stanford Law School; \*Carl Shapiro is the Transamerica Professor of Business Strategy at the Haas School of Business at the University of California at Berkeley; (May 2018, “How Antitrust Law Can Make FRAND Commitments More Effective”, <https://www-cdn.law.stanford.edu/wp-content/uploads/2018/05/How-Antitrust-Law-Can-Make-FRAND-Commitments-More-Effective.pdf>)

2. Why Antitrust Enforcement Is Necessary

Some SSO members have an interest in ensuring that the SSO takes steps to minimize the potential harms from the SEP holders’ monopoly power, and this undoubtedly explains in part why most SSOs have adopted FRAND policies or similar requirements. But, as shown in the economic model in the Appendix,73 SSOs **cannot** in general **be counted on** to adopt effective FRAND policies. The bases for this conclusion, which is central to our argument for the applicability of Section 1 to SSO FRAND rules, can be summarized as follows.74

First, the SSO members **collectively have an interest** in permitting SEP holders to charge supracompetitive royalties that elevate the downstream price of compliant devices to the monopoly level. Doing so will enable the members **in aggregate** to collect **increased revenues** from consumers, and thus to generate **increased profits** that in theory could be **shared by all** the members. In other words, supracompetitive royalties can enrich industry participants as a group at the expense of final consumers. This fact alone should serve as a **clear and strong signal** regarding the **dangers** of counting on SSOs to implement effective FRAND policies: if the SSO members negotiate **efficiently**, the outcome will be **just as bad** for consumers as if the members agreed to **fix downstream prices**.75 The **fundamental problem** is that **final consumers** are **not at the table** when the SSO rules are negotiated.

Second, SSO members that own SEPs but earn little or no profits as implementers have a **powerful self-interest** in being able to exercise the ex post monopoly power associated with their SEPs. Because SSO policies are usually determined by a **consensus** process, these members will likely be able to **block the adoption** of **fully effective FRAND policies**. Moreover, these SSO members often have the greatest interest in SSO patent policies. Since much of their income may be attributable to patent licensing, they can be expected to devote substantial resources to block the adoption of FRAND policies that effectively prevent patent holdup.

Third, even SSO members that earn **significant profits** as implementers may have **mixed incentives** if they also own SEPs, which can also lead to **weak or in-effective FRAND rules**. In the Appendix, we show that, if the **requisite share** of votes in the SSO are cast by firms whose **share of SEP royalties** is at least as large as their share of **downstream profits**, and if these firms can coordinate their voting over the FRAND rules, then an SSO **unconstrained** by antitrust laws will establish FRAND rules leading to an outcome **no better for consumers** than would result from an **integrated monopolist** controlling all SEPs and all downstream sales.76

Fourth, even SSO members that are **downstream implementers** and own few, if any, SEPs may have only a **modest interest** in promoting effective policies to restrict ex post opportunism. Because all implementers will be subject to the opportunism, all of them will face **increased licensing costs**, and therefore will likely be able to **pass on** most or all of the **increased costs** to their customers.77 Furthermore, these implementers might not be **especially active** or **effective** in the standard-setting process for **free-riding** or **public-good** reasons, especially if SEP royalties constitute only a **relatively small portion** of the costs of their standard-implementing products. Public choice theory predicts that the highly motivated SEP holders are likely to have the **greatest influence** over **patent policies**.

Empirical evidence bears out these concerns. As a starting point, we find it striking that SSO FRAND rules are almost **always quite vague**.78 Notably, SSOs in which SEP holders are more prevalent tend to have weaker FRAND rules.79 Further, to our knowledge, SSOs have made almost **no effort** to enforce their FRAND rules and have, instead, **left enforcement** efforts to **others**.80 This evidence raises serious doubts about the effectiveness of the existing FRAND rules in preventing ex post opportunism.

#### Antitrust is critical---the broad standing and available remedies afforded are vastly superior to any other types of law.

Cary et al. 11, \*Messrs. George Cary and Alex Sistla are members of the California and District of Columbia Bars. Mr. Mark Nelson is a member of the New York and District of Columbia Bars. Mr. Steven Kaiser is a member of the New Jersey and District of Columbia Bars; (2011, “THE CASE FOR ANTITRUST LAW TO POLICE THE PATENT HOLDUP PROBLEM INSTANDARD SETTING”, <https://www.clearygottlieb.com/~/media/organize-archive/cgsh/files/publication-pdfs/the-case-for-antitrust-law-to-police-the-patent-holdup-problem-in-the-standard-setting.pdf>)

III. CONCLUSION

Patent holdup where a patentee has deceived an SSO in order to secure a position in the standard is, at its core, an antitrust problem. In this context, patent holders harm consumers by exploiting the competition-reducing aspects of standard setting to their own private advantage. In addition to being the body of law directed toward anticompetitive conduct, antitrust provides numerous practical advantages, including the possibility of governmental enforcement, and appropriately broad standing.

Remedying the patent holdup problem exclusively through non-antitrust legal remedies would be perverse. Indeed, it would be a bit like remedying patent infringement through the doctrine of common law conversion. In some instances, it might work, but there certainly would be under-enforcement.

To be sure, there are instances where deceptive conduct by the patentee does not harm competition and, in those instances, there is no antitrust claim. Often there will be patent remedies in that situation, or contract or even tort remedies. The legal regimes can and do coexist peacefully.

Those who argue that the marginal benefit of antitrust remedies do not out-weigh the cost of antitrust litigation both understate the benefits (broad standing and ready remedies where appropriate) and overstate the costs (the potential, however unknown, of “false positives,” i.e., condemning behavior that is not anticompetitive). In addition to being overstated, the false positives concern is also misplaced in this context. Unlike an antitrust attack on price cutting or a securities offering, the risk of a false positive here is not the over-deterrence of desired behavior, but rather that over-deterrence of deceptive and opportunistic behavior. Fretting about that form of over-deterrence seems itself to be a misallocation of resources. And preventing that form of over-deterrence by reliance on the competitive outcomes under legal regimes not designed to protect competition strikes us as unwise.

#### \*Ex ante disclosure solves lock-in, improves transparency and openness.

Contreras 13, \*Jorge L. Contreras is a Presidential Scholar and Professor of Law at the University of Utah with an adjunct appointment in the Department of Human Genetics. He is a graduate of Harvard Law School (JD) and Rice University (BSEE, BA); (Contreras, J. L. (2013). TECHNICAL STANDARDS AND EX ANTE DISCLOSURE: RESULTS AND ANALYSIS OF AN EMPIRICAL STUDY. Jurimetrics, 53(2), 163-211. Retrieved from https://www2.lib.ku.edu/login?url=https://www.proquest.com/scholarly-journals/technical-standards-ex-ante-disclosure-results/docview/1428261870/se-2?accountid=14556)

Ex ante disclosure of licensing terms could potentially alleviate the causes of such disputes by making a patent holder's royalty rate known before lock-in of a standard. Thus, if maximum royalty rates were known in advance, it would be more difficult for an implementer to argue that such rates were unreasonable (as the SDO could have chosen an alternative technology if this were the case).148 Lacking this potential defense against an infringement claim by the patent holder, implementers might be more inclined to negotiate with patent holders before the adoption of a standard. By the same token, if a patent holder knew that its maximum royalty rate would be scrutinized before the approval of a standard, and that SDO participants would be free to consider alternative, less costly technologies, it would have an incentive to disclose a royalty rate that was as reasonable (or low) as possible.149

Ex ante disclosure of licensing terms has an intuitive appeal. Like the prices of menu items at a restaurant, it has been argued that the royalty rates for standards-essential patents should be disclosed before product vendors (diners) are locked into costly technology choices. But critics of ex ante disclosure have argued that requiring early disclosure of licensing terms will impede standards-development processes and create additional legal risks for participants. To assess the validity of these complaints, we studied ex ante licensing disclosures at VITA, IEEE and IETF and found no evidence that such policies resulted in measurable negative effects on the number of standards started or adopted, personal time commitments or quality of standards, nor was there compelling evidence that ex ante policies caused the lengthening of time required for standardization or the depression of royalty rates. There was evidence to suggest that the adoption of ex ante policies may have contributed to positive effects observed on some of these variables. In addition, a significant majority of participants in VITA, the only SDO adopting a mandatory ex ante policy, felt that the information elicited by the organization's ex ante policy improved the overall openness and transparency of the standards-development process. Thus, while there are numerous areas in which further study and analysis may be warranted, and other organizations in which the implementation of ex ante policies may have different effects, we concluded that the process-based criticisms of ex ante policies and the predicted negative effects flowing from the adoption of such policies are not supported by the available evidence.

# 2AC

## Adv — Innovation

## Adv — Cyber

## T — Of

#### Prohibitions expand the scope

Bradford and Chilton 18 (Anu Bradford, Henry L. Moses Professor of Law and International Organization, Columbia Law School. Adam S. Chilton, Assistant Professor of Law and Walter Mander Research Scholar @ the University of Chicago. “Competition Law Around the World from 1889 to 2010: The Competition Law Index” , Columbia Law School Scholarship Archive Faculty Scholarship, <https://scholarship.law.columbia.edu/cgi/viewcontent.cgi?article=3519&context=faculty_scholarship> , 2018, date accessed 9/5/21)

The Scope Index is the closest to the CLI in that it also measures the law in the books, treating prohibitions as elements that increase the scope (or stringency) of the law and defenses as elements that reduce the scope (or stringency) of the law. Basic categories in the Scope Index and our CLI are also the same, even if somewhat differently labeled. For example, we refer to “anticompetitive agreements” where the Scope Index refers to “restrictive trade practices.”

## K — Cap

#### Both advantages impact turn the K---they’re robust defenses of innovation, which the alt can’t solve.

Kornai 13, \*János Kornai is a Hungarian economist and the Allie S. Freed Professor of Economics Emeritus at Harvard and Professor Emeritus at Corvinus University of Budapest; (János, November 6th, 2013, “Dynamism, Rivalry, and the Surplus Economy”, DOI:10.1093/acprof:oso/9780199334766.001.0001, Google Books)

C. There is no competition between producers and sellers. Production is strongly concentrated. Many companies enjoy monopolist positions, or at least a (regional) monopoly in producing an entire group of products. The chronic shortage of products creates monopolistic behavior even when many producers operate in parallel. The shortage economy, one of the strongest system-specific properties of socialism, ~~paralyzes~~ impedes the forceful engine of innovation, the incentive to fight for the favors of the customer ( Kornai 1971 ; 1980; 1992, chapters 11 – 12 ). The producer/seller is not compelled to attract the buyer by offering him a new and better product, since the latter is happy to get anything in the shop, even an obsolete and poor-quality product.

There are examples of inventive activities motivated by chronic shortages: ingeniously created substitutes for missing materials or machinery parts (Laki 1984 –1985). These results of the inventors’ creative mind, however, do not become widespread, commercially successful innovations in the Schumpeterian sense. 25 Table 2.1 features only one revolutionary innovation that did not appear first in a capitalist country but, rather, in the Soviet Union: synthetic rubber. Its inventor had been doing research on the subject for decades; the employment of it in industry was rendered necessary by the shortage of natural rubber.

D. The tight limits of experimenting. Capitalism allows for hundreds or thousands of barren or barely fruitful attempts, so that, afterward, one out of the hundreds or thousands would succeed and bring immense success. In the socialist planned economy, actors are inclined to avoid risks. As a result, the application of revolutionarily significant innovations are more or less excluded, since those always mean a leap into the dark, as success is necessarily unpredictable. As far as followers are concerned, some economies follow up quickly, others slowly. The socialist economies belong to the group characterized by the slowest pace. They prefer to maintain the already known, old production procedures, and produce the old well-tried products; new technologies and new products have too many uncertain characteristics making the planning of the directives difficult.

E. There is no capital waiting to be utilized; investment allocation is rigid. Central planning is not miserly with the resources devoted to capital formation. The share of investment carved out from the total output is typically higher than in the capitalist economies. However, this enormous volume is appropriated ahead of time to the last penny. Moreover, most of the time over-allocation takes place; in other words, the ensemble of all project plans prescribes the requisition of more resources than the required amount to execute the plan. It never happens that unallocated capital is waiting for someone with a good idea. The allocators do not search for an entrepreneur waiting to step forward with a proposal for innovation. Flexible capital markets are unknown. Instead, the rigid and bureaucratic regulation of project activities takes place, and to devote capital resources to activities with possibly uncertain outcomes is unconceivable. No foolish minister of industry or factory manager could be found who would demand money for ventures admitting in advance that the money may be wasted and the innovation may not succeed. 26

#### The link assumes the aff is about preservation of pure unfettered competition or pure capitalism — antitrust enforcement is about restraining capitalism to reduce its harmful effects while assuring that the benefits are spread equitably.

Parakkal et al 13 Raju Parakkal is Assistant Professor of International Relations, Philadelphia University, Sherry Bartz-Martinez is Visiting Assistant Professor, Department of Economics, University of Capitalism, democratic capitalism, and the pursuit of antitrust laws, Antitrust Bulletin; London Vol. 58, Iss. 4, (Winter 2013): 693-729.

An equally important reason why capitalism per se did not matter for antitrust adoption is that—notwithstanding some of their obvious links—capitalism and antitrust are “transactionally incongruent.” Capitalism demands freedom of trade and commerce. For its part, antitrust does seek to supply this freedom; however, antitrust goes further than that, and hence, the incongruity. Antitrust also aspires to create an equitable marketplace and to protect the less-empowered sections of society, typically the consumers and small and mediumsized businesses. The incongruity matters because these additional goals of antitrust are seemingly incompatible with a pure form of capitalism and therefore negate the possibility of a direct and automatic causal link between capitalism and antitrust. However, these additional goals that antitrust supplies—equity in the marketplace and protection of the weaker actors—unmistakably satisfy the demands of a democratic society. And that is why a democratic form of capitalism demonstrates a strong and positive impact on the adoption of antitrust laws. If we continue on this line of thought and analysis, we observe that an antitrust law truly embodies the goals of both capitalism and democracy by seeking to promote competition and free enterprise (largely a capitalistic goal) and protect society’s “little guys” (largely a democratic goal). 79 Therefore the synergistic nature of the relationship between capitalism and democracy easily manifests itself in an antitrust law. This synergy stems from their shared emphases on personal freedom and individual choice. It is due to this synergy that these two dominant systems can interact to produce a new kind of political economy that is called democratic capitalism. And that is the reason antitrust laws connect more intrinsically with democratic capitalism rather than with a pure form of capitalism. An antitrust law is not only compatible but it is also commensurate in its “normativity” with a political economy of democratic capitalism. The fact that antitrust laws go beyond the demands of capitalism and that democratic capitalism better explains antitrust adoption is evident from a closer examination of the national antitrust laws of some of the countries in the sample. For illustrative purposes, we focus on the competition laws enacted by India and South Africa. The Competition Act of 200280 enacted by India is an excellent illustration of the capitalism-democracy tango as reflected in its new antitrust law. Due to its above-average scores for both capitalism and democracy, India has a relatively high democratic capitalism score in the dataset used for this study. It therefore follows from the findings of this study that India would adopt an antitrust law that sought to promote the twin goals of both capitalism and democracy as discussed above. And that’s exactly what India did. In 2002, India enacted a new antitrust law that unequivocally states at the outset that its objectives are “to provide . . . for the establishment of a Commission to prevent practices having adverse effect on competition, to promote and sustain competition in markets, to protect the interests of consumers and to ensure freedom of trade carried on by other participants in markets”. 81 Promoting and sustaining competition and freedom of trade are clearly capitalistic goals while protecting the interests of consumers and other market participants satisfy the democratic aspirations of equity and fairness. The repeated emphases on the protection and promotion of competition, consumers, freedom of trade, and other market participants point to how a democratically capitalistic society adopts an antitrust law that seeks to supply the society with the demands of both capitalism and democracy.

#### Democratic capitalism maximizes economic benefits and equality

Kenworthy 17 Lane Kenworthy. Professor of Sociology and Yankelovich Chair in Social Thought University of California-San DieSocial Democratic Capitalism Lane Kenworthy December 31, 2017, <https://lanekenworthy.files.wordpress.com/2018/01/sdc20171231chs12.pdf>

The experience of the world's affluent nations suggests that social democratic capitalism is the configuration of institutions and policies most likely to yield the things we want in a good society, including community, democracy, economic equality, economic opportunity, economic prosperity, economic security, economic stability, education, employment, environment, family, finance, freedom, good government, happiness, health, housing, inclusion, information, law and order, openness and support for other peoples, privacy, and safety.1

#### Extinction outweighs---our framing shifts security policy from a national to existential frame---solves their threat K’s.

Sears 20, \*Nathan Sears, PhD Candidate in Political Science at The University of Toronto and Trudeau Fellow in Peace, Conflict and Justice at the Munk School of Global Affairs (April 17th, 2020, “Existential Security: Towards a Security Framework for the Survival of Humanity,” https://onlinelibrary.wiley.com/doi/10.1111/1758-5899.12800)

‘Existential security’ responds to a similar set of questions as alternative security frames (see Table 2). Security for whom? The ‘referent object’ of existential security is humanity. Security is therefore about humanity’s survival . Security for which values? The ‘values’ to be secured are, at the minimum, the survival of humanity (i.e. the biological entity of the human species and cultural entity of human civilization), and, at the maximum, the long‐term prosperity of human civilization and the planet. The security of humankind ranges from the survival of existing human beings and societies to past and future generations of humanity – the past whose memory is recorded in history and preserved by the present, and the future whose possibilities of existence depend on actions taken in the present. Existential security therefore adopts an intergenerational perspective of security, not only for utilitarian reasons (e.g. quantifying the potential gains/losses in ‘future lives’) (Baum, 2015; Bostrom, 2002, 2013; Torres, 2017), but also because the significance of humankind – that is, all its past sufferings, present achievements, and future potential – is at stake, since existential risks simultaneously threaten humanity’s past, present, and future (Morgenthau, 1961).

How much security? Nick Bostrom (2013, p. 19) proposes the principle of ‘maxipok’, in which security policy would seek to ‘maximise the probability of an “OK outcome”, where an OK outcome is any outcome that avoids existential catastrophe’. While reducing the probability of existential risk to ‘zero’ may be impossible, the amount of security should be determined by a level of risk‐aversion equivalent to existential threats. Since thinking in terms of ‘worst‐case scenarios’ is a common practice in the security domain, and since some ‘worst‐case scenarios’ could include civilizational collapse or human extinction, this should imply a strong aversion to risk. Although there are logical limits to the ‘precautionary principle’ with respect to existential risks,10 it has practical implications for security policy, such as taking preventive, cost‐effective, and long‐term oriented action (Clarke, 2005). More generally, making (existential) security a priority does not imply the sacrifice of all other values (e.g. political liberty, economic wealth), but it does mean that potential gains in other values be weighed against potential losses in security. Security is always a question of degree (Wolfers, 1952).

From what threats? Existential security is concerned with those threats that have their origins in human agency and could bring about civilizational collapse or human extinction. This requires broadening the security agenda beyond its conventional focus on ‘security from violence’, while excluding ‘natural’ existential risks (e.g. asteroids and supervolcanos). There are two main reasons for emphasizing anthropogenic threats. The first is the low probability of natural risks on timescales relevant to humanity (Bostrom, 2013; Bostrom and Cirkovic, 2008;), whereas anthropogenic threats are, by definition, relevant to human timescales, including the twenty‐first century (Rees, 2003). The second is that many prevention/mitigation strategies for anthropogenic existential threats act on their drivers in human agency, which makes little sense for natural risks. The spectrum of anthropogenic existential threats includes threats to international peace and security (e.g. nuclear war), dangers from human intervention in the natural environment (e.g. climate change), and risks from emerging technologies (e.g. AI). Existential security must take into account the complex relationships between human, environmental, and technological systems, as well as inherent uncertainties about existential threat scenarios (e.g. ‘nuclear winter’, ‘hothouse Earth’, or ‘superintelligence’).

By what means and modes of protection? The existential security frame requires innovation in the means and modes of security policy. This is because the conventional emphasis on military capabilities and balancing is either inadequate (e.g. nuclear war), irrelevant (e.g. climate change), or counterproductive (e.g. AI). Moreover, the pursuit of relative gains/losses in security is fundamentally misguided for anthropogenic existential threats, since – as a general principle – either all human societies are safe, or none of them are. Existential security requires a paradigm shift from thinking about security policy as a matter of (national) ‘defense’ to being a matter of (global) ‘governance’. Governance is not an end in itself (e.g. the creation of a ‘world state’), but rather a means to security (i.e. the survival of humankind). The pursuit of existential security requires means of protection that involve a comprehensive set of political, economic, and technological resources – not merely military capabilities. The modes of protection are primarily ‘restraint’ and ‘resilience’. Restraint is a prevention strategy, while resilience is a mitigation strategy, which take on different forms for different threats. For the nuclear threat, restraint manifests itself in the policies of disarmament, arms control, and nonproliferation, while resilience comes mostly in the form of nuclear bunkers and shelters (Bull, 1961; Deudney, 2007). For climate change, restraint is primarily about limiting greenhouse gas emissions and the degradation of carbon sinks, while resilience is about making societies less vulnerable to heat stress, rising seas, food and water scarcities, new diseases, and human migration (Wallace‐Wells, 2019; World Bank, 2012). For AI, restraint entails the slow and careful development of AI (Bostrom, 2014) – or perhaps forgoing the ‘AI dream’ altogether (Joy, 2000) – while resilience is about reducing societal vulnerability to technological disruption (e.g. cybersecurity). Importantly, the growing survival interdependence of human societies implies that restraint and resilience must be mutual to be effective. If only some states choose disarmament or nonproliferation, if some societies reduce carbon emissions while others increase them, or if one technology firm decides to rapidly pursue ‘superintelligence’, then the (in)action of some actors may affect the security of all humankind. This emphasis on mutual restraint and resilience contrasts with the national security frame's emphasis on ‘self‐help’.

#### Tech and innovation solve warming — red innovation is wrong

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/. accessed 4-16-2019//JDi

\*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.

#### Capitalism is good and sustainable---technological progress has successfully dematerialized economic growth.

McAfee 19, \*Andrew Paul McAfee, a principal research scientist at MIT, is cofounder and codirector of the MIT Initiative on the Digital Economy at the MIT Sloan School of Management; (2019, “More from Less: The Surprising Story of How We Learned to Prosper Using Fewer Resources and What Happens Next”, https://b-ok.cc/book/5327561/8acdbe)

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 get ting 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.

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.

#### Economic growth is responsible for drastic improvements in global living standards, and is the only path for future improvements.

Cowen 18, \*Tyler Cowen is a Holbert L. Harris Professor at George Mason University and Director of the Mercatus Center; (October 16th, 2018, “Stubborn Attachments: A vision for a society of free, prosperous, and responsible individuals”, <https://www.goodreads.com/en/book/show/31283667-stubborn-attachments>)

How good is growth, anyway ?

The history of economic growth indicates that, with some qualifications, growth alleviates misery, improves happiness and opportunity, and lengthens lives. Wealthier societies have better living standards, better medicines, and offer greater personal autonomy, greater fulfillment, and more sources of fun. While measured wealth does not exactly correspond to Wealth Plus, these two concepts have come pretty close to one another in the past, especially across the range of outcomes we have observed (as opposed to hypothetical thought experiments and counterfactuals).

We often forget how overwhelmingly positive the effects of economic growth have been. Economist Russ Roberts reports that he frequently polls journalists about how much economic growth there has been since the year 1900. According to Russ, the typical response is that the standard of living has gone up by around fifty percent. In reality, the U.S. standard of living has increased by a factor of five to seven, estimated conservatively, and possibly much more, depending on how we measure prices and the values of outputs over time, a highly inexact science.

The data show just how much living standards have gone up. In 1900, for instance, almost half of all U.S. households (forty-nine percent) had more than one occupant per room and almost one quarter (twenty-three percent) had over 3.5 persons per sleeping room. Slightly less than one quarter (twenty-four percent) of all U.S. households had running water, eighteen percent had refrigerators, and twelve percent had gas or electric lighting. Today, the figures for all of these stand at ninety-nine percent or higher. Back then, only five percent of households had telephones, and none of them had radio or TV. The high school graduation rate was only about six percent, and most jobs were physically arduous and had high rates of disability or even death. In the mid-nineteenth century, a typical worker might have put in somewhere between 2,800 and 3,300 hours of work a year; that estimate is now closer to 1,400 to 2,000 hours a year. 6

Until recently, polio, tuberculosis, and typhoid were common ailments, even among the rich. U.S. presidents George Washington, James Monroe, Andrew Jackson, Abraham Lincoln, Ulysses S. Grant, and James A. Garfield all caught malaria during their lives. Antibiotics and vaccines have existed for only a tiny fraction of human history, and it is no coincidence that they emerged in the wealthiest time period humanity has ever seen. There is also a strong and consistent relationship between wealth and rates of infant mortality; small children do best when they are born into wealthier countries, and that is because wealth supplies the resources to take better care of them.

As recently as the end of the nineteenth century, life expectancy in Western Europe was roughly forty years of age, and food took up fifty to seventy-five percent of a typical family budget. The typical diet in eighteenth-century France had about the same energy value as that of Rwanda in 1965, the most malnourished nation for that year. One effect of this deprivation was that most people simply did not have much energy for life.

In earlier time periods, most individuals performed hard physical labor, and a college or university education—or even a high school education—was a luxury. Leisure time has risen with economic growth. In 1880, about four-fifths of individuals’ discretionary time was spent working, according to economist Robert Fogel. Today we spend about fifty-nine percent of our time doing what we like, and that may rise to seventy-five percent by 2040. 8

The splendors of the modern world are not just frivolous baubles; they are important sources of human comfort and well-being. Imagine that a time traveler from the eighteenth century were to pay a visit to Bill Gates today. He would find televisions, automobiles, refrigerators, central heating, antibiotics, plentiful food, flush toilets, cell phones, personal computers, and affordable air travel, among other remarkable benefits. The most impressive features of Gates’s life, seen from the point of view of a person from the eighteenth century, are those shared by most citizens of wealthy countries today. My smartphone is as good as his. The very existence of an advanced civilization—the product of cumulative economic growth—confers immense benefits to ordinary citizens, including their ability to educate and entertain themselves and choose one life path over another. For further arguments along these lines, I recommend Steven Pinker’s recent book, Enlightenment Now: The Case for Reason, Science, Humanism, and Progress . 9

The economic growth of the wealthier countries benefits the very poor as well, though sometimes with considerable lags. The distribution of wealth changes over time, and not all growth trickles down, but as an overall historical average, the bottom quintile of an economy shares in growth. 10 You can see this by comparing the bottom quintile in, say, the United States to the bottom quintile in India or Mexico.

The richer economy can also do more to elevate the living standards of immigrants. Poor people who move to rich countries usually receive higher incomes and have better living conditions, and their children do better still. The richer the receiving country, the more new immigrants tend to benefit. Central American immigrants to the United States do better than Central American immigrants to Mexico or Nepalese immigrants to India. Immigrants also send remittances back home at a rate that far exceeds governmental foreign aid. Actual upward mobility in the United States far exceeds what the usual numbers indicate, because published statistics on upward mobility do not typically include a comparison with pre-immigration outcomes.

But the chain of benefits does not stop there. Migrants will often return to their home countries, bringing new skills and new business connections. Both India and Israel have developed vibrant technology and software scenes precisely because of their close ties with the start-up scene of the United States. English-language universities in English-speaking countries have trained many thousands of Asian students in science and engineering, again leading to new businesses and, eventually, higher economic growth in their home countries.

New medicines and technologies developed in wealthy nations also make their way to the rest of the world, as illustrated most conspicuously by the rapid spread of the cell phone and now the smartphone. One study predicts that if the leading twenty-one industrial countries were to boost their R&D by half a percentage point of GDP, U.S. output alone would grow by fifteen percent. But it doesn’t end there: output in Canada and Italy would grow by about twenty-five percent, and the output of all industrial nations would increase by 17.5 percent, on average. In the less economically developed countries, output would increase by about 10.6 percent on average. 11

Although these historical processes have often embodied unfairness and long lags of decades or more, economic growth has nonetheless brought wealth to the poor and elevated their status. The Greek city-states and the Roman Empire benefited from maritime trade across the Mediterranean; those regions in turn spread growth-enhancing institutions around Europe, Northern Africa, and the Middle East. The commercial revolution of the late Middle Ages and Renaissance reopened many of the trade routes of antiquity, and eventually human beings started to climb out of the Malthusian trap of very low per capita incomes at subsistence. The wealth of the West helped to enable the export miracles of the East Asian economies. Today, most poor countries seek greater access to wealthier Western and Asian markets, and flourish if they can achieve it. 12

For all the recent increases in inequality within individual nations, global inequality has declined over the last few decades, in large part because of growth in China and India. And the growth in these emerging nations was largely driven by earlier growth in the West and in East Asia. China, for instance, engaged in “catch-up” growth by adopting Western technologies and exporting to the wealthier nations. China has gone from being a quite poor nation to a “middle-income” nation with a sizable middle and upper class.

Although recent media coverage has focused almost exclusively on within-nation magnitudes, recent world history has been an extraordinarily egalitarian time. It is above all else a story about how global economic growth helps the poor. There has been a squeezing of the middle class in the wealthier nations, in part because of increasing global competition. Still, we have seen economic growth, aggregate wealth, and global income equality all rising together over the last twenty-five years. Many citizens in East Asia, South Asia, and Latin America have seen significant gains in their standard of living, and much of this has been a trickle-down effect from the earlier growth of the wealthier countries. Much of Africa is now following suit, bolstered in part by China’s demand for raw materials, and also by the spread of modern technologies such as affordable cell phones. 13

Sometimes extended periods of growth do not confer full or fair benefits to the poor or lower classes, for instance during the early phase of the British Industrial Revolution in the late eighteenth century. Still, the historical record suggests that it was better for Britain to push ahead with economic growth, as this eventually drove the greatest boost in living standards the world has ever seen. To be sure, there were probably better policies which, had they been adopted, would have distributed the benefits of growth more widely (e.g., fewer wars and Poor Law reform and free trade for the British). But even taking misguided policies into account, Britain fared better by pursuing economic growth rather than turning its back on the idea, even though significant real wage gains for the working class often did not arrive until the 1840s.

Nobel Laureate Amartya Sen has promoted the idea of “capabilities” as, if not quite a substitute for economic growth, then an alternative focus. Sen points out that our positive opportunities in life often matter more than the amount of cash in our bank accounts. He also notes that some parts of the world, such as the state of Kerala in India, have relatively good health and education indicators, even though their per capita incomes are relatively low.

Sen’s points are well taken, but they do not put a fundamental dent in the relevance of wealth, or, as I am calling it here, Wealth Plus. The significant benefits accrued from capabilities, such as health benefits, are accounted for in Wealth Plus, even if they are not properly represented in current GDP measures. In other words, Kerala is wealthier than some limited statistical measures imply. Wealth and good social outcomes are still strongly correlated on average, and this correlation is stronger over longer time horizons. For instance, if Kerala does not grow much in more narrow economic terms, it is unlikely to look so impressive in its social indicators fifty or one hundred years from now. Even today, Kerala manages as well as it does in large part because so many Keralans take jobs in wealthier countries, especially in the Gulf States, and send money back home. And compared to other Indian states, Kerala has an above-average measure of wealth, as well as above-average consumption expenditures, both of which are accounted for in traditional statistics. 14

The truth is that economic growth is the only permanent path out of squalor. Economic growth is how the Western world climbed out of the poverty of the year 1000 A.D. or 5000 B.C. It is how much of East Asia became remarkably prosperous. And it is how our living standards will improve in the future. Just as the present appears remarkable from the vantage point of the past, the future, at least provided growth continues, will offer comparable advances, including, perhaps, greater life expectancies, cures for debilitating diseases, and cognitive enhancements. Billions of people will have much better and longer lives. Many features of modern life might someday seem as backward as we now regard the large number of women in earlier centuries who died in childbirth for lack of proper care.

#### Economic data restricts biases, promotes critical thinking, and prevents flawed decision-making errors---rejecting economists plagues public discourse with innumeracy that results in worse outcomes.

Ip 17, \*Greg Ip is a Canadian-American journalist, currently the chief economics commentator for The Wall Street Journal. A native of Canada, Ip received a bachelor's degree in economics and journalism from Carleton University in Ottawa, Ontario; (August 25th, 2017, “In Defense of the Dismal Science”, https://www.wsj.com/articles/in-defense-of-the-dismal-science-1503679118)

Thus, when economists preach the virtues of globalization, market solutions or cost-benefit analysis, they sound to critics on the left like corporate shills lacking any moral anchor. To critics on the right, they sound like globalist elites who despise patriotism.

Yet it is precisely their love of numbers that makes economists invaluable. By stripping the emotions from pressing problems, economists can often illuminate the most practical ways to tackle them—but only if ordinary people and their representatives are prepared to listen.

Economics emerged in the 1700s as an offshoot of moral philosophy. Known then as political economy, its pioneering practitioners—such as David Hume and Adam Smith —believed that liberating individual self-interest, rather than following religious or political authority, maximized society’s well-being.

Smith made this case most memorably in “The Wealth of Nations” (1776), in which he famously invoked the benevolent “invisible hand” of the free market. But for today’s economists, David Ricardo’s “The Principles of Political Economy and Taxation,” published in 1817, was even more of a breakthrough.

Most people aren’t surprised if a doctor, who could be a better caregiver to her children than a nanny, chooses instead to spend that time seeing patients and pays a nanny out of what she earns. Thanks to Ricardo, economists know that the same principle applies to countries. The average American worker can probably make more tires than a foreign worker, but his edge at producing grain is even greater—and thus the U.S. should export grain and import tires. This theory, known as “comparative advantage,” is both counterintuitive and powerful.

Ricardo went further, extolling the pacifying power of free trade: It “binds together, by one common tie of interest and intercourse, the universal society of nations throughout the civilized world,” he wrote. Most economists still agree that globalization fosters political stability and cooperation.

Non-economists have always found this emphasis on material interests and motives somewhat distasteful. In 1790, Edmund Burke, who was friends with Hume and Smith, wrote in “Reflections on the Revolution in France,” “The age of chivalry is gone. That of sophisters, economists, and calculators has succeeded; and the glory of Europe is extinguished forever.”

The influence of economists truly blossomed in the 20th century. The Great Depression gave birth to macroeconomics, the study of how consumption, investment, income and interest rates interact in the aggregate.

In search of better tools to manage the economy, the federal government commissioned economists in the 1930s to calculate gross national product. Convinced that the economy could no longer be left to its own devices, Congress passed the Employment Act in 1946, which established, among other things, a Council of Economic Advisers to provide the president with the necessary expert guidance.

The next year, Paul Samuelson’s seminal book, “Foundations of Economic Analysis,” used mathematics to formalize the key axioms of economics. He touched off a revolution that equipped economists with ever more powerful methods for explaining and analyzing economic behavior. They increasingly adopted the trappings of the physical sciences, hoping to achieve a similar degree of objective truth and predictive power.

Math did clarify economic thinking, but it didn’t improve its forecasting accuracy, which remains dreadful. Virtually no economists predicted the financial crisis of 2007-08 and the recession that followed. Nor has economics rid itself of bias. Economists who advise presidents and prime ministers routinely shape their analyses to validate particular political views.

In recent decades, the stature of economists has taken a beating from two critiques in particular. The first, popular especially on the left, argues that economists are slaves to the assumption that individuals act rationally and in their own best interests. These critics point to psychological and experimental evidence that shows how often people violate the axioms of Econ 101: Our spending and investment habits are often driven by emotions, rules of thumb, ignorance and shortsightedness. The financial crisis seemed to be the ultimate proof, as highly paid bankers and traders, armed with state-of-the-art economic techniques, took on so much risk that they nearly destroyed the global financial system.

Economists consider national borders and sovereignty annoying obstacles to the free flow of goods, capital and people.

The second critique originates from populist, nativist and nationalist movements in the world’s more prosperous countries. Economists consider national borders and sovereignty annoying obstacles to the free flow of goods, capital and people. The new movements of the right see them as essential preconditions for national identity and cohesion. Many Britons voted for Brexit because control over immigration and their laws mattered more to them than the pecuniary advantages of the European common market.

These trends have fed a broader mistrust of experts and elites. During last year’s election campaign, Mike Pence, Mr. Trump’s vice-presidential running mate, dismissed statistical evidence of the U.S. economy’s health by saying, “People in Fort Wayne, Indiana, know different.” In the months after Mr. Trump’s victory, his team wondered whether it should even appoint a chairman of the Council of Economic Advisers. (The administration eventually nominated Kevin Hassett, a highly regarded economist from the conservative American Enterprise Institute.)

In Greece, economists aren’t simply mistrusted; they’re prosecuted. During the 2000s, Eurostat, the EU’s statistical arm, had repeatedly questioned the accuracy and political independence of Greek statistics. Soaring deficits in 2009 triggered a crisis and forced Greece to seek a bailout in 2010. Mr. Georgiou, a Greek native who received his Ph.D. from the University of Michigan and spent 21 years at the International Monetary Fund, took over Greece’s statistical agency that August. Officials had already shown previous debt and deficit figures to be understated. He revised them further upward and earned for his agency a clean bill of health from Eurostat.

Politicians of the left and right accused him of inflating Greece’s debts to justify its creditors’ demands for austerity. Prosecutors charged him with making false statements and improperly disseminating statistics without his board’s approval. Courts acquitted him, but the second set of charges was reinstated, resulting in this month’s conviction. Mr. Georgiou, who now lives in a suburb of Washington, D.C., plans to ask Greece’s supreme court for a retrial.

Mr. Georgiou says that his real offense, in the politicians’ eyes, was breaking from the past practice of “resisting” and “negotiating” with outsiders, such as the EU, over what official Greek data would show. The politicians needed a scapegoat to preserve their own “political narratives,” he says. He calls the implications of his case “terrifying” for other professionals responsible for economic statistics.

Economists bear some blame for the public and political backlash. Their disagreement with populist policies has often colored their predictions. British economists, including Mr. Carney, thought that Brexit would unleash so much uncertainty that markets and the economy would tank. American economists foresaw similar swoons if Mr. Trump became president. Both were wrong, at least thus far: Economies in both countries have chugged along, and stock markets in particular have soared. There may be long-term costs, of course, but those may be hard to detect.

Economists didn’t predict the financial crisis, but they did help to arrest it.

But such misjudgments don’t justify the charges leveled at economists. Take, for example, their inability to predict financial meltdowns. Crises almost by definition are unpredictable. In a recent essay, Ricardo Reis, an economist at the London School of Economics, argues that failing to foretell a financial crash is no more an indictment of economics than failing to predict when a patient will die is an indictment of medicine. Economists didn’t predict the financial crisis, Prof. Reis notes, but they did help to arrest it by applying theory and experience: “The economy did not die, and a Great Depression was avoided, in no small part due to the advances of economics over many decades.”

Another caricature of economists is that they try to emulate physicists, fetishizing elegant, abstract mathematical models disconnected from economic reality. Paul Romer, the chief economist at the World Bank, derisively calls this approach “mathiness.” The critique is certainly fair in some corners of academia, but it is increasingly untrue of the profession as a whole.

In 1963, roughly half the papers published in the top three American economics journals were theoretical, according to a tally by Daniel Hamermesh, now at Royal Holloway, University of London. By 2011, that figure had shrunk to 28%; the remainder were empirical papers based on public data, on data gathered by the authors or on experiments. Economic debates these days are won not by the best theory but by the best data: Statistics are more important than calculus. Economists are far more obsessed with measurement than with math. When public discourse is plagued by innumeracy, this capacity to count is no small thing.

Economists are also instinctively skeptical of simple explanations. They are trained to look for equilibrium, which is another way of saying, “When you change one thing, how do other things respond? Where do things settle once all interactions have occurred?”

Advocates for a higher minimum wage extol the benefits to workers. Economists ask: Will it change employers’ demand for workers who earn the minimum wage? Or what they pay workers who earn just above the minimum? Or the prices they charge, or how much market share they lose to companies that don’t face the higher minimum or how much they invest in automation? Does it reduce turnover and thus make workers more productive?

Advocates of tariffs on imported steel focus on the benefit to domestic steelmakers and their workers. But economists ask: What happens to steel-consuming companies that now face higher prices, as well as to their workers and customers? Does penalizing imports boost the dollar and hurt U.S. exports?

The more data economists collect, the better they can map such complex interactions. Seemingly simple questions seldom have simple answers. A higher minimum wage helps workers in some circumstances but hurts them in others. Tariffs help some workers but hurt many others. Global warming will do some economic harm, but not enough to justify banning fossil fuels.

Sometimes, this attachment to numbers conveys a false precision. Critics say that the Congressional Budget Office overestimated how many people would get insurance under Obamacare and must therefore be overestimating how many will lose it if the law were to be replaced. But the CBO always warned that its estimates were highly uncertain; what no economists doubted, including those working in Mr. Trump’s administration, is that the number would be large. Economists could confidently predict that price controls would lead to shortages in Venezuela, though not how severe they would be.

Non-economists see all this as hopeless equivocation, but it is actually the way that evidence drives science. Economists still have their ideological leanings, but data has helped to restrict these biases. Surveys of top academic economists by the University of Chicago show considerable agreement, even among liberals and conservatives.

For example, the scholars almost all agree that fiscal stimulus reduced unemployment after the last recession and that trade with China benefits Americans by providing them with cheap goods. A study by Gordon Dahl and Roger Gordon of the University of California, San Diego, found that disagreement among economists was greatest where the empirical research was most sparse, as with the issue of whether natural-gas fracking helps U.S. exports.

Though economics remains an imperfect science, it has come a long way in 200 years. Its greatest challenge today isn’t the quality of the analysis it supplies, but whether there is still sufficient demand for it.

#### Regulated cap is key to sustainability.

Rebecca M. Henderson 20, Harvard’s John and Natty McArthur University Professor, based at Harvard Business School, and a research fellow at the National Bureau of Economic Research, “Reimagining Capitalism in the Shadow of the Pandemic,” Harvard Business Review, 7/28/2020, https://hbr.org/2020/07/reimagining-capitalism-in-the-shadow-of-the-pandemic, kyujin

The Pandemic’s Challenges — and Opportunities

Capitalism is one of the great inventions of the human race — an unparalleled source of prosperity, opportunity and innovation. We won’t solve the problems that we face without it. To solve inequality, we need good jobs — and lots of them. To solve climate change, we need (among other things) to transform the world’s energy, transportation, and agricultural systems. Only the relentless pressure of the free market can drive this kind of transformative innovation at scale.

In this context, the pandemic is both a massive challenge and an opportunity. A challenge because more than a half a million people have died, the global economy has been massively disrupted, and tens of millions of people have lost their jobs. A challenge because the combination of deep economic disadvantage — at the beginning of May nearly 61% percent of Hispanic and 44% of Black households had experienced a job or wage loss due to the corona virus, for example, compared with 38% percent of whites — and the killings of George Floyd, Ahmaud Arbery, Breona Taylor and countless others have brought anger and calls for justice to our streets. The world will almost certainly be poorer, more divided, and more fearful in 2021 than it was in 2019.

It’s an opportunity because it has also shown us so vividly what is wrong. Inequality is no longer simply an abstract idea. It’s a reality that many “essential” workers must show up even when they’re sick because they have no savings and no paid leave. That racism is not something that was solved by the civil rights movement. As the skies clear and early research suggests that the reduction in fossil fuel pollution is saving lives, the costs of continuing to rely on dirty energy have become much more tangible. Watching states bid against each other for vital medical equipment while the federal government fumbles its response to the virus has made the reality of our broken politics very clear.

The pandemic has reminded us that we stand and fall as a society and that the welfare of the poorest among us is integral to everyone’s welfare. It has shown us that planning for the future is essential and that, when the chips are down, a capable, responsive government is a necessity, not a dirty word. We’ve learned that when we must do something, we can: Fundamental change no longer seems impossibly out of the reach.

We can do better. We already have the resources and the knowledge we need to build a more equitable, sustainable capitalism. But to get there, business will have to change how it understands its role in the world (and in the U.S. in particular) — and how it thinks about government.

A New Path Forward

While free markets are an unparalleled source of prosperity and freedom, the free market can only take us where we need to go if externalities such as carbon pollution are properly priced, if there is genuine freedom of opportunity, and if the rules of the game are such that competition is free and fair. Markets do not police themselves; they must be balanced by transparent, capable, democratically accountable governments.

Today — in large part due to the rise of shareholder primacy, the increasing role of money in politics, and the systematic attack on government as a necessary or effective institution — that balance is largely absent. As a result, one of the fastest routes to profitability is often to persuade politicians to write the rules in your favor. Firms feel free to dump greenhouse gases into the atmosphere, for example, while spending hundreds of millions of dollars to lobby against carbon regulation. We’re even seeing this dynamic in the U.S. government’s response to the pandemic: It’s increasingly clear that an uncomfortably large share of the benefits from the recent stimulus has gone to very large firms and to very wealthy individuals.

I’m not suggesting that firms neglect their duty to their shareholders. Focusing on profitability is essential if a company is to thrive in today’s brutally competitive market. But profit maximization has always been a means to an end, justified by the idea that when markets are genuinely free and fair, there’s good reason to believe they lead to both prosperity and freedom.

But when markets are no longer held in check by governments that can police the rules of the game, appropriately control externalities, or provide the public goods necessary to support real opportunity, they become too powerful for their own good. The chaotic and uneven pandemic response we are experiencing today flows directly from 30 years of treating government as something that should be “drowned in the bathtub.”

Now more than ever, I believe firms have not just a moral duty to contribute to the health of the institutions that keep our society strong and our capitalism genuinely free and genuinely fair, but also an economic interest in doing so. We need to rebuild our democracy, strengthen our public conversation so that it’s firmly based on facts and mutual respect, commit with everything we have to building an inclusive society for everyone, and yes, find ways to rediscover the importance of democratically accountable, capable, responsive government.

Why? We cannot decarbonize the world’s energy supply without government regulating fossil fuel emissions and providing positive incentives to embrace low carbon solutions. Yes, individual firms can provide better jobs — paying employees a decent wage and providing ongoing training, among other necessary steps — but we’ll only successfully address inequality and racism at scale through structural reform, if we can do things like: provide quality education and health care to everyone, no matter their parents’ income; raise the minimum wage; and find ways to give employees more power as they negotiate with increasingly powerful firms. Most fundamentally, we’ll only rebuild trust in the political system, and with it a government that is genuinely responsive to ordinary people, if we can get money out of politics and stop tolerating business’s attacks on government. These attacks are often framed in terms of defending the free market, but too often are simply attempts to block the action we need to build a more equitable society.

Collective action — a sustained effort by coalitions of firms — could make a huge difference in helping to drive this kind of institutional change. Firms are already working together to solve some of the world’s toughest problems. A third of the world’s invested capital is already committed to insisting that the firms in their portfolios plan for the challenge of climate change. Businesses across the world are increasingly coming to realize that democratically accountable, freely elected, capable governments are critical to long term economic health — and are willing to say so in public. But they need to do more.

A “Kodak Moment” for the World

I can feel your skepticism as I write. Can business really change — and help government change along with it? Can it embrace a version of capitalism that focuses on the longer term and the common good? Can it help to rebuild the power of the very institutions that are needed to keep it in check?

I believe it can. We already know that it is possible to make money by addressing the world’s social and environmental problems. Walmart saved a billion dollars in fuel costs by increasing the efficiency of their trucking fleet. Elon Musk has revolutionized the automotive business and built a company worth more than GM and Ford combined in the process. The most successful $200M+ IPO of the last 20 years was a company that promised to replace beef with a burger made largely from soy. At Unilever, so called “purpose-driven” brands are growing 69% faster than the rest of the portfolio as consumers increasingly vote with their wallets.

Change on a broader scale will be much harder. But not impossible. Think of this as a “Kodak moment” for the world. I spent the first 20 years of my career at MIT as a professor of innovation and strategy. For much of it I was quite literally the Eastman Kodak professor of management. My title was a coincidence — but a deeply ironic one, since I spent most of my time trying to understand why large, successful firms like Kodak had so much trouble responding effectively when the world around them changed.

By now the company’s story is well-known: Kodak was once one of the world’s most successful firms. The firm invented classic film-based commercial photography and used it to build one of the world’s most iconic brands. As one senior vice president and director of Kodak research noted in a 1985 Wall Street Journal article, “We’re moving into an information-based company…[but] it’s very hard to find anything [with profit margins] like color photography that is legal.” But Kodak went bankrupt in 2012, having failed to master the transition to digital photography.

The business community now faces a similar transition. As the Business Roundtable’s historic decision last year to “lead their companies for the benefits of all stakeholders” suggested, the vast majority of the world’s leading firms know that we must tackle the challenge of climate change, that we must find a way to ensure that everyone has a chance to share in the world’s wealth, and that it’s vital that we not let democracy lose out to either oligarchy or tyranny. We know that we need to change. But too often it’s tempting to emulate Kodak, claiming that change will come — but not now. Insisting that it’s more profitable to stick with the old ways, that if it’s really important we’ll get around to doing something new — later. Change is hard. It’s not surprising that we’re struggling to adopt new ways of thinking about the world and business’s role in it.

But I am hopeful. Not optimistic, in the sense that I’m sure everything will work out just fine — I’m not sure of that at all. But hopeful. As a species, we have a gift for problem solving. Kodak failed to manage the digital transition, but Nikon, Canon and Fujifilm continue to be billion-dollar companies. Thousands of firms and millions of people are even now exploring ways to solve our common problems — for example, firms are partnering with each other and with governments to search for vaccines and to bring people back to work safely. This kind of cooperation must continue beyond the pandemic. As recent data shows, trust in business has fallen during the pandemic, but trust in government has risen dramatically. There is no better time for business to see government as a partner, not an adversary, in helping to make society work everyone — not just the lucky few.

We can learn from the horrors of the pandemic. We must. We don’t need to go back to “normal” — we need to reimagine capitalism instead. We need to find a way to balance the energy of the free market with the power of competent, responsive government. Together, they can help us build a more just and sustainable world.

#### Transition is impossible.

Milena Büchs & Max Koch 18. \* Associate Professor in Sustainability, Economics and Low Carbon Transitions at the Sustainability Research Institute, University of Leeds. For CREDS, she is working on the Excess Travel team, modelling high travel demand and identifying interventions for high travel demand reduction. \*\* Professor at Lund University. Visiting Scholar / Guest Professor at Universidad Complutense de Madrid, Erasmus University Rotterdam, Glasgow University, Programa de Economía del Trabajo (Santiago de Chile), Lund University (prior to my current employment), GESIS - Leibniz Institute of the Social Sciences in Cologne, University of Edinburgh and at the Institute for Advanced Sustainability Studies in Potsdam. 9-20-18. “Challenges for the degrowth transition: The debate about wellbeing.” <https://doi.org/10.1016/j.futures.2018.09.002>. DOA: 2-22-2020. KD-NCP.

‘Locked’ into growth and rising wellbeing expectations? Having set out in the previous sections the discussion about wellbeing in the degrowth discourse so far, we now examine two additional wellbeing related challenges to the political feasibility of degrowth. First, it can be argued that the dominance of growth-based economics has taken on a ‘structural’ quality in current societies. This means that a transition to degrowth that can successfully support wellbeing would need to involve very fundamental social, economic, political, cultural and technological changes – some of which are difficult to achieve through political means. Second, these changes would ideally need to happen very fast, to present a meaningful response to the climate change crisis. We argue here that the process of transition itself is likely to bring about challenges for achieving aspired wellbeing outcomes. Third, and based on the argument that the framework of universal basic needs is most appropriate for discussing wellbeing in a degrowth context, we raise the question how well (or not) applying this framework to think about wellbeing aligns with current societies’ wellbeing expectations. 3.1. Growth ‘lock in’ Economic growth, as an attribute of market capitalism, has structural properties – it is needed to stabilise modern societies as it provides employment, public sector provision through tax revenues, rising wages, and hence social stability ([Petridis et al., 2015: 178](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0375), [Rosa et al., 2017](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0405)). Economic growth is organised around and shapes a range of tightly coupled structures, including institutions, norms, discourses, culture, technologies, competences, identities, etc. Historically speaking, growth is a fairly recent phenomenon which only picked up in the 19th century together with the industrialisation of Western economies. In a co-evolutionary process, a range of institutions developed which are now coupled to a growth-based capitalist economy, including the nation state, representative democracy, the rule of law and current legal, financial, labour market, education, research, and welfare systems. These are based on philosophies which emerged to justify and give meaning to these institutions, for instance on individualism, freedom, justice, sovereignty, or power. The embeddedness of the growth-based capitalistic economic system in these co-evolved institutions and ways of thinking makes it difficult to transition to a degrowth system because the change of the economic system would need to involve a parallel transformation of those coupled systems. In Luhmann’s words, the constitution of the current system “defuturises” ([Luhmann, 1976: 141](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0305)) the future, it reduces the “openness” of the future; “path dependency” or even “lock-in” are related expressions that capture this idea. Two examples which directly link to people’s wellbeing can illustrate this point: the relationship between welfare states and growth, and between growth and people’s mind-sets and identities. The satisfaction of needs is influenced by the character of socio-economic institutions, including the ways in which work, welfare, retirement, health, education and family life are governed; as well as by the structure of the distribution of a range of resources that support health and wellbeing. Welfare state institutions play an important role in these areas in high income economies, and they are closely coupled with economic growth ([Bailey, 2015](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0015)). Rising economic prosperity in the post Second World War period provided the resources for establishing welfare states in Europe and elsewhere, and the funding of current welfare state institutions is closely coupled to economic growth as it largely depends on income-related taxes and [social security contributions](https://www.sciencedirect.com/topics/social-sciences/social-security-contributions). The positive relationship between economic growth and welfare states in many ways also works the other way round: welfare states support growth by enhancing the population’s health and education levels, providing unemployment and minimum income benefits for people out of work. This helps to increase productivity, maintain consumer demand, and more generally contain and minimise social conflict through redistribution and institutionalised conflict resolution between employers and employees. Evidently, a fundamental [reorganisation](https://www.sciencedirect.com/topics/social-sciences/reorganization) of the economic and welfare system would be required under degrowth to sustain investments in health, education, and the reduction of poverty and [inequality](https://www.sciencedirect.com/topics/social-sciences/inequality). This will be crucial in a context of decreasing material and financial resources, because if left unmanaged, this could provide fertile ground for new social conflicts with potentially detrimental implications for wellbeing. Various degrowth authors have made suggestions for alternative welfare institutions and policies, including working time reduction and redistribution as mentioned above ([Victor & Rosenbluth, 2007](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0460)), a basic income ([Gorz, 1980](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0190); [Dietz & O’Neill, 2013: 94](https://www.sciencedirect.com/science/article/pii/S0016328718300715#bib0110)), and, from a Marxian perspective, the establishment of a cooperative economy in which businesses will be worker-owned and managed ([Blauwhof, 2012](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0020)). These are all relevant suggestions, however, it should not be underestimated how radical the changes to existing social systems are that these new institutions represent. They challenge deeply entrenched ways of thinking about rights, justice, freedom, private property, individual responsibility, etc. A change of these deeply rooted ‘logics’ on which these institutions are based is not impossible, but very difficult to steer with political means. This point closely links to the idea that economic growth is not only at the core of various socio-economic institutions but is also very deeply anchored in people’s minds, bodies and identities which is likely to make the transition to degrowth additionally challenging. The concept of social practices helps us understand the ways in which agents (and their mind-sets and bodies) and broader social structures are continuously implicated and reproduced in the performance of social life ([Büchs & Koch, 2017: ch. 6](https://www.sciencedirect.com/science/article/pii/S0016328718300715#bib0060)). From this perspective, economic growth is not just an external premise that actors can decide to act upon or not, but it is a principle with structural properties that is engrained in ways of thinking and acting – for the most part habitually. Growth thus becomes something that is perceived as ‘natural’ by the vast majority of actors. A range of scholars have argued that the growth paradigm is deeply embedded in people’s minds and bodies ([Göpel, 2016](https://www.sciencedirect.com/science/article/pii/S0016328718300715#bib0185); [Lane, 1991](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0285); [Welzer, 2011](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0475); [Büchs & Koch, 2017: ch. 6](https://www.sciencedirect.com/science/article/pii/S0016328718300715#bib0060)). This implies that people’s identities and life goals are closely aligned with the idea of growth – shaped by ideas of social progress, personal status and success through careers, rising income and consumption. Even seemingly alternative goals such as ‘personal fulfilment’ can be infused with ideas that remain tied to the growth paradigm, for instance if fulfilment is sought through high consumption and high emissions practices such as extensive long haul travel or expensive hobbies and gadgets. As [Meadows (1999)](https://www.sciencedirect.com/science/article/pii/S0016328718300715" \l "bib0325) has pointed out, the most effective, but also the most difficult step in system transformation is the shift of paradigms that underpin the system. Again, since this is difficult to influence politically, it presents a major hurdle for a departure from growth-based systems that also maintains wellbeing.

#### Capitalism isn’t intrinsically racist---the relationship is contingent even if the two systems have coincided.

Go 21, Professor of Sociology and Faculty Affiliate in Asian Studies @ Boston University. He has held Visiting Fellowships and Professorships @ the London School of Economics, Pompeu Fabra University in Barcelona, University of Lucerne in Switzerland, and the Third World Studies Centerin the Philippines. (Julian, "Three Tensions in the Theory of Racial Capitalism", *Sociological Theory*, Volume: 39 issue: 1, <https://doi.org/10.1177/0735275120979822)---language> edited

Necessity, Contingency, and Difference

The final tension within racial capitalism is whether the interconnectedness of racial difference and capitalism is a logical or contingent necessity.6 If, as the racial capitalism literature suggests, slavery and its associated logics of racism have been crucial for the development of capitalism, and if global capitalism today remains intertwined with racial stratification, to what extent are these relations intrinsic to capitalism or accidental? Put differently, is capitalism necessarily racist (Fraser 2019; Lemann 2020)?7

For some, the relationship is only contingent. Walzer (2020) argued that in some countries, capitalism proceeds along just fine without racial difference, and if there is racial difference on a global scale, it is historically contingent. Although the vast majority of workers are nonwhite, Walzer suggested that this is not due to any intrinsic logic of capitalism but rather the accident of demographics (because most of the world is nonwhite, the majority of the world’s workers will be nonwhite). For this reason, Walzer suggested we disavow the racial capitalism concept. Alternatively, others claim that racism is indeed intrinsic to capitalism.8 There are two versions of this claim. One is that racism is necessary to divide the working class and legitimate the rule of the bourgeoisie. Racism is an ideological necessity of capitalism, justifying its unequal relations (Camp, Heatherton, and Karuka 2019; McCarthy 2016; Taylor 2016). “Capitalism requires inequality,” suggested Gilmore (2015), “and racism enshrines it.” A very different version, coming most predominantly from Fraser (2019), is that capitalism necessarily entails relations of exploitation and expropriation that feed off each other. Exploitation is the extraction of value from “free subjects” through wage labor. But expropriation, which includes slavery and colonialism, extracts value from racialized “dependent subjects” and is what enables exploitation to happen in the first place. Expropriation is “a necessary background condition for the exploitation of ‘workers’” (Fraser 2019) and therefore for capitalism itself. Capitalism is thus logically dependent upon racism.9

So what is the answer? Again, it helps differentiate between a theory of capital and a theory of capitalism. A theory of capitalism might demonstrate that race has been historically necessary for capitalist accumulation by reference to empirical reality: historically, capitalism and race have always been intertwined. But the claim that race is a logical necessity to capitalism would have to derive from a theory of capital, not from empirics alone. One would have to deduce, from the categories of Marx’s theory, the necessity of racism or racial differentiation in society. On this score, the arguments for the logical necessity of capitalism’s entanglements with race fall short.

Consider the argument that racism is necessary for capitalism because capitalism requires racist ideology to divide the working class. This is a functionalist argument that is not functionalist enough, for it effaces the logical possibility of functional substitution. We may find that racism has historically always functioned to divide the working class, but in theory other “isms” could serve the same function. There is nothing inherent to the logic of capital that requires race to be the ideology of division (Lebowitz 2006:39).10 Why not ethnicity? Why not sexuality? Consider Fraser’s argument that expropriation is intrinsic to capitalism and that racial differentiation must be too. It is plausible and indeed persuasive to claim that expropriation is necessary for capitalism, but it is less persuasive to claim that racial difference is logically necessary for expropriation. Gender could easily serve as the main axis of dependent classification (and, to feminist-Marxist thought, it has served that function), as could ethnicity, religion, sexuality, or citizenship. Fraser would have to show that expropriation, and hence capitalism, requires a racial classification as opposed to other social categories. This is a task left unfulfilled.11

#### The alt fails, re-inscribes state power, and causes mass violence

Flaherty 5, USC BA in International Relations, researcher in political affairs, activist and organic farmer in New Zealand (Kevin Flaherty, 2005, “Militant Electronic Piracy: Non-Violent Insurgency Tactics Against the American Corporate State,” Cryptogon, <http://cryptogon.com/docs/pirate_insurgency.html>)

\*ACS: American Corporate State

THE NATURE OF ARMED INSURGENCY AGAINST THE ACS

Any violent insurgency against the ACS is sure to fail and will only serve to enhance the state's power. The major flaw of violent insurgencies, both cell based (Weathermen Underground, Black Panthers, Aryan Nations etc.) and leaderless (Earth Liberation Front, People for the Ethical Treatment of Animals, etc.) is that they are attempting to attack the system using the same tactics the ACS has already mastered: terror and psychological operations. The ACS attained primacy through the effective application of terror and psychological operations. Therefore, it has far more skill and experience in the use of these tactics than any upstart could ever hope to attain.4 This makes the ACS impervious to traditional insurgency tactics.

- Political Activism and the ACS Counterinsurgency Apparatus

The ACS employs a full time counterinsurgency infrastructure with resources that are unimaginable to most would be insurgents. Quite simply, violent insurgents have no idea of just how powerful the foe actually is. Violent insurgents typically start out as peaceful, idealistic, political activists. Whether or not political activists know it, even with very mundane levels of political activity, they are engaging in low intensity conflict with the ACS.

The U.S. military classifies political activism as “low intensity conflict.” The scale of warfare (in terms of intensity) begins with individuals distributing anti-government handbills and public gatherings with anti-government/anti-corporate themes. In the middle of the conflict intensity scale are what the military refers to as Operations Other than War; an example would be the situation the U.S. is facing in Iraq. At the upper right hand side of the graph is global thermonuclear war. What is important to remember is that the military is concerned with ALL points along this scale because they represent different types of threats to the ACS.

Making distinctions between civilian law enforcement and military forces, and foreign and domestic intelligence services is no longer necessary. After September 11, 2001, all national security assets would be brought to bare against any U.S. insurgency movement. Additionally, the U.S. military established NORTHCOM which designated the U.S. as an active military operational area. Crimes involving the loss of corporate profits will increasingly be treated as acts of terrorism and could garner anything from a local law enforcement response to activation of regular military forces.

Most of what is commonly referred to as “political activism” is viewed by the corporate state's counterinsurgency apparatus as a useful and necessary component of political control.

Letters-to-the-editor...

Calls-to-elected-representatives...

Waving banners...

“Third” party political activities...

Taking beatings, rubber bullets and tear gas from riot police in free speech zones...

Political activism amounts to an utterly useless waste of time, in terms of tangible power, which is all the ACS understands. Political activism is a cruel guise that is sold to people who are dissatisfied, but who have no concept of the nature of tangible power. Counterinsurgency teams routinely monitor these activities, attend the meetings, join the groups and take on leadership roles in the organizations.

It's only a matter of time before some individuals determine that political activism is a honeypot that accomplishes nothing and wastes their time. The corporate state knows that some small percentage of the peaceful, idealistic, political activists will eventually figure out the game. At this point, the clued-in activists will probably do one of two things; drop out or move to escalate the struggle in other ways.

If the clued-in activist drops ~~his~~ or her political activities, the ACS wins.

But what if the clued-in activist refuses to give up the struggle? Feeling powerless, desperation could set in and these individuals might become increasingly radicalized. Because the corporate state's counterinsurgency operatives have infiltrated most political activism groups, the radicalized members will be easily identified, monitored and eventually compromised/turned, arrested or executed. The ACS wins again.

- ACS Full-Spectrum PSYOP Dominance

The ACS wields the most powerful weapon of political control the world has ever seen: the mass media. This is the corporate state's trump card against leaderless resistance movements which are impossible to infiltrate and compromise by counter-insurgency teams. The appearance of legitimacy is all that matters in a low intensity conflict, and the ACS, with the corporate media running continuous propaganda and perception management campaigns, represents the final solution to what the public will view as legitimate.5

All anti-corporate/anti-government political activism will be portrayed by the ACS as ~~lunatic~~ muckraking and a potential hotbed of terrorism. All violent insurgency activities will be portrayed as terrorist acts. (Some criminal activity is now considered terrorism by the ACS.) The behavior of the ACS will be represented as just, measured and prudent, regardless of the ghastly nature of its atrocities. The general population will be bombarded with images, sound bites and articles about the threats posed by the “terrorists.” In other words, the population, rather then fearing the state and its continuous cryptofascist operations and more overt international war crimes and economic exploitation, will come to view the insurgents as a threat and the ACS as their savior. The ACS can punctuate the point by unleashing false flag terror incidents on the population while conveniently blaming any organization it wishes, including other states.6 The general population will respond by supporting: foreign wars, the diminution of individual rights, and legislation and funding that adds to the power of the corporate state.

#### White supremacists coopt the alt

Culp & BondGraham 14, \*teaches Media History and Theory in the MA Program in Aesthetics and Politics and the School of Critical Studies at CalArts \*\*The Oaklandside News Editor, former investigative reporter covering police and prosecutorial misconduct, reported on gun violence for The Guardian (Andrew Culp, Darwin BondGraham, 5-29-2014, "Left Gun Nuts," CounterPunch, https://www.counterpunch.org/2014/05/29/left-gun-nuts/)

The more radical variant of this argument is that “the people” need guns to wage an eventual revolution and liberate themselves from the shackles of the state and corporate America.

Gun control need not dampen the spirit of those still hoping for a revolution, even if such a revolution is highly unlikely to happen in our lifetimes. What stands in the way of such leftist dreams are the vast majority of current gun owners. Over-represented among current gun owners are white reactionary men, the types who regularly expresses their desire to shoot on sight the “Muslim socialist” president of the United States, and who “muster” along the U.S.-Mexico boarder with their weaponry to defend the nation against “alien” immigrants. As it stands, toxic gun culture would coopt any new American revolution with a lethal cocktail of supercharged masculinity, racism, and provincialism fantasized about in post-apocalyptic scenes. If the United States ever comes to another civil war, the first thing to die under a barrage of lead will be our hope for a more just and democratic society; guns would empower warlords with petty political agendas, not egalitarian-minded freedom fighters.

The most likely cultural shift away from reactionary gun ownership will not happen in cooperation with the Right and their politics, but against it. Gun control is the best place to start. Disarming the Right will do more to advance goals toward a revolutionary democratic transformation of America than trying to beat the Right-wingers (and the U.S. government!) in an arms race.

Of course Left insurrectionists who advocate the right to bear arms are more focused on the U.S. Government as the singular impediment to their variant of utopia. This dream is sadly a classic example of radical posturing done in the name of some distant hypothetical moment, and it ignores the actual harm that guns cause each and every day. In the real world, guns kill upwards of 30,000 Americans every year, virtually all of these deaths serving absolutely no political purpose in the fight for a more democratic society. Most of these deaths are just tragic accidents or suicides, many of which would not end in death if guns were not in the mix. Left fantasies about armed struggle are the same half-baked ideas as those held by the secessionist Right. What varies for Leftists is the template of decolonial struggles; yet a leftist revolution in the United States would not kick out a small minority of foreign occupiers, as happened in India and Vietnam, but would be a fight amongst settler colonialists for political authority. This is why the worn “Zapatistas defense” touted by the radical left is a bad analogy for the United States context – the Zapatistas started a peasant rebellion that kicked outsiders off their landbase, a task for which wooden cutouts of guns turned out to be more effective than the real thing.