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#### Advantage 1---Smart Pricing:

#### Algorithmic pricing is a legal gray area, the plan builds confidence

Metz 20 [ ROSA M. ABRANTES-METZ & ALBERT D. METZ, economists with The Brattle Group in the Competition and Securities Practices. Rosa Abrantes-Metz is a former Adjunct Associate Professor of Economics at the New York University Stern School of Business. Albert Metz is a former Group Managing Director at Moody’s Investor Services. “PRICING ALGORITHMS AND COLLUSION: IS THERE CLARITY ON WHAT CORPORATIONS MAY BE ON THE HOOK FOR?” November 2020. https://www.brattle.com/insights-events/publications/brattle-experts-author-article-on-how-pricing-algorithms-affect-competition-in-cpi-antitrust-chronicle/]

As discussed above, what a collusive pricing algorithm may look like falls into a somewhat gray and undefined area. Pricing algorithms could be seen as coordination among competitors, which could be potentially collusive. But do the current FTC/DOJ 2000 Guidelines offer enough guidance in this regard? As explained by the FTC when addressing “Dealings with Competitors:”

“In today’s marketplace, competitors interact in many ways, through trade associations, professional groups, joint ventures, standard-setting organizations, and other industry groups. Such dealings often are not only competitively benign but procompetitive. But there are antitrust risks when competitors interact to such a degree that they are no longer acting independently, or when collaborating gives competitors the ability to wield market power together.

For the most blatant agreements not to compete, such as price fixing, bid rigging, and market division, the rules are clear. The courts decided many years ago that these practices are so inherently harmful to consumers that they are always illegal, so-called per se violations. For other dealings among competitors, the rules are not as clear-cut and often require fact-intensive inquiry into the purpose and effect of the collaboration, including any business justifications. Enforcers must ask: what is the purpose and effect of dealings among competitors? Do they restrict competition or promote efficiency?”7

When broadly seen, the Guidelines provide a general framework of analysis for all forms of coordination among competitors. But if we are not sure what a collusive pricing algorithm really looks like (short of literal information transfers), how are we going to be able to apply the framework provided?

Let us also not forget the question of whether pricing algorithms could learn to collude by themselves, without “direct/explicit” human influence. Is there liability, and, if so, where does it lie? What is the “proof” of explicit collusion, and who will be going to jail?

Corporations need guidance on all of these questions and others. Official “Best Practices” for pricing algorithms would be welcome so that corporations are not suddenly caught off-guard for conduct for which a clear standard has not been established. Given the rapid adoption of pricing algorithms across a multitude of industries, this is better provided sooner rather than later.

#### Revising FTC policy is key. Current interpretation causes “complete unpredictability”

Ballou 21 [Brendan, Trial Attorney, Antitrust Division, U.S. Department of Justice. Reviewed in 32 Stanford Law & Policy Review 213 (2021). “THE “NO COLLUSION” RULE”. 9/16/21. https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3793881]

A critic may reasonably argue that the FTC can already bring enforcement actions against companies for engaging in tacit collusion; why, then, is a rule necessary? Primarily because the federal judiciary has asked for such guidance. As described above, the FTC has indeed brought successful enforcement actions against companies for engaging in tacit collusion. Where the FTC has stumbled, however, it has often been because of its failure to articulate its “unfair methods of competition” authority. In E.I. du Pont, for instance, the Court set aside the FTC’s judgment, explaining that:

[T]he Commission owes a duty to define the conditions under which conduct claimed to facilitate price uniformity would be unfair so that businesses will have an inkling as to what they can lawfully do rather than be left in a state of complete unpredictability. The Commission’s decision in the present case does not provide any guidelines . . . . Thus the FTC’s rulings and order appear to represent uncertain guesswork rather than workable rules of law.190

The No Collusion Rule would solve precisely the Commission’s concern about justiciable standards by providing a clear standard for what constitutes unacceptable tacit collusion: While companies can consider each other’s prices in setting their own, competitors’ prices cannot be the sole consideration in such decisions.

#### That guts investment

Michèle Finck 18, Senior Research Fellow at the Max Planck Institute for Innovation and Competition and Lecturer in EU Law at Keble College, University of Oxford, “Law & The New Economy: Blockchains: Regulating the Unknown”, German Law Journal, 19 German Law Journal 665, Lexis

I. Regulatory Stability Is a Means of Innovation and Growth

First, we must reiterate that regulation is useful not only from the perspective of the regulator, but also of the regulated. Regulation creates legal certainty, which in turn frees entrepreneurs and innovators from the concern that their activity may be suddenly be qualified as illegal. Such concerns generate hesitant innovators, shy of eventually realizing their vision, or driven to flee the jurisdiction to establish themselves in more friendly territory. Looking back at an earlier wave of digital innovation, the emergence of the Internet, while initially skeptical, tech companies eventually welcomed regulatory intervention. 91 This can be explained by the certainty provided through such intervention in the form of clear rules applicable to all players. Similar tales emerge from the more recent phenomenon of the platform economy. Airbnb has long sought dialogue with regulators and accepted regulation to operate in various locations. 92 Its notoriously reluctant counterpart from the transportation industry, Uber, has now pushed for insurance legalization that applies unanimously across the United States. 93 As Werbach highlighted, "if anything, the innovators stand to lose the most by delaying the involvement of government in adopting reasonable solutions." 94

Regulatory uncertainty creates additional negative externalities. In addition to negatively affecting entrepreneurial courage, it increases the costs of legal compliance as entrepreneurs must go to great lengths to clarify their legal situation, if possible. This is particularly problematic for small players and the many not-for-profit distributed ledger initiatives. Such a state of affairs further increases the risk of litigation, which in turn swells legal costs for companies. It will also give rise to a determination of applicable rules on a case-by-case basis, which would be ill-advised for all parties involved. An absence of [\*684] regulatory guiding principles moreover risks leaving public policy considerations unprotected.

#### Collusive algorithms prevent upside benefits and require widening legal standards

Gal 19 [Michael, Professor and Director of the Forum for Law and Markets, University of Haifa Faculty of Law; President, International Association of Competition Law Scholars. “ALGORITHMS AS ILLEGAL AGREEMENTS “. 2019. Berkeley Technology Law Journal, Vol 34:67, DOI: https://doi.org/10.15779/Z38VM42X86]

The use of algorithms in digital markets creates many benefits. Algorithms allow consumers to efficiently compare products and offers online, enabling them to enjoy lower-priced goods or find products that better fit their preferences.3 Suppliers can quickly and efficiently analyze large amounts of data, allowing them to better respond to consumer demand, better allocate production and marketing resources, and save on human capital.4 To achieve these results, algorithms perform a myriad of tasks, including collecting, sorting, organizing and analyzing data, making decisions based on that data, and even executing such decisions.

Some of these advantages are currently threatened by algorithmic facilitated coordination among competitors. 5 Algorithms, some researchers argue, make coordination among suppliers easier and quicker than ever before. The higher levels of interconnection and transparency in digital markets, combined with more available data and a higher level of sophistication of analysis, makes reaching a joint profit-maximizing equilibrium easier. The speed and ease of detection and response to deviations from the coordinated equilibrium reduces incentives to break ranks. Joseph Harrington, Professor of Business Economics and Public Policy at Wharton Business School, argues that given developments in algorithmic agents, “the emergence of [coordination] . . . in actual market settings would seem extremely possible in the near future, if it is not already occurring.”6 Ariel Ezrachi and Maurice Stucke, Professors of Law at Oxford and the University of Tennessee, respectively, suggest in their seminal work on virtual competition that this effect is so strong, it marks the end of competition as we know it.7

Should algorithms indeed facilitate coordination in markets otherwise not prone to it, market participants and regulators need to explore what tools, if any, can be used to reduce the negative welfare effects of algorithmic facilitated coordination on both consumer and social welfare.8 While previous work suggested a (partial) market solution, 9 this Article focuses on legal remedies. In particular, this Article explores whether by applying laws that were designed to regulate human-facilitated market coordination we are limiting ourselves to looking only under the proverbial lamppost, while the activities we are interested in take place in the dark. If so, can we address this problem by using a stronger light bulb (i.e., widening the scope of existing laws by way of interpretation)? Or do we need to create a new source of light altogether (i.e., new laws)? Indeed, algorithms challenge the assumptions on which antitrust law is currently based. To illustrate, algorithms, unlike humans, can “read the minds” of other algorithms even before they perform any action, thereby transforming the need for an explicit commitment to coordinate or to punish deviations.10 This new reality requires us to rethink concepts that stand at the basis of our laws, like the meeting of minds, intent, consent, and communication, and possibly requires us to create a new taxonomy to fit the algorithmic world. The analysis is timely: competition authorities all over the world are starting to explore such issues in depth, and the legality of algorithmic-facilitated coordination is likely to become a major issue, given rapid advancements in machine learning.

#### Solves microgrid roll-out and resilient urban infrastructure

Ko and Adil 16, [Ali M. Adil a , Yekang Ko b,n a Urban Planning and Public Policy Program, College of Architecture, Planning and Public Affairs, University of Texas at Arlington, United States b Department of Planning and Landscape Architecture, College of Architecture, Planning and Public Affairs, University of Texas at Arlington, United States, Socio-technical evolution of Decentralized Energy Systems: A critical review and implications for urban planning and policy, https://www.researchgate.net/profile/Ali-Adil-2/publication/289528499\_Socio-technical\_evolution\_of\_Decentralized\_Energy\_Systems\_A\_critical\_review\_and\_implications\_for\_urban\_planning\_and\_policy/links/5a04f634458515eddb81e9d9/Socio-technical-evolution-of-Decentralized-Energy-Systems-A-critical-review-and-implications-for-urban-planning-and-policy.pdf]

2.3.1. Smart MicroGrids: building blocks of Smart Grid A key difference between Microgrids and Smart Grids is the scale of technology-driven optimization. Microgrids denote a more efficient distribution-scale optimization as described earlier, and Smart Grid represents a large-scale transmission network upgrade through information and communication technologies (ICTs) [88]. While the smart grid vision is predicated on progressively upgrading the entire grid network, implementation of microgrids with ICT enabled energy management capabilities denotes the decentralized version of achieving the same vision – from the ground up. According to Asmus [88], not only is the latter approach more economic and efficient, it offers the much needed innovation in distribution network applications. Several authors also identify the value of a coupled or multi-microgrid concept towards achieving the smart grid vision of energy systems transformation. For instance, the improved operation and management capabilities from a multi-microgrid (MMG) design facilitates higher integration levels of microgrids, and hence RET, into the grid network [105]. The MMG concept is further linked to the smart grid vision; smart grid implementation is simplified by breaking it down into distribution scale implementation and optimization of grid-coordinated MicroGrids [68]. Furthermore, this decentralized version of smart grid implementation helps acknowledge multi-source, multi-product and multi-agent based systems where several energy sources, several locally specific end uses and multiple stakeholders are involved [106–108]. 2.3.2. Technology-enabled innovation at the distribution scale Although consumer involvement through captive (for self-use) or participative (for cooperative production and consumption) energy generation is independent of additional ICT implementation, Smart MicroGrids prove to be intelligent versions of 'dumb' MicroGrids [88]. As such, the degree of smartness of microgrids is greatly supplemented by incorporating ICT, which increase the system interoperability with proximate microgrids as well as with the larger grid network. For instance, dynamic pricing systems enabled by smart meters encourage (or discourage) consumption to shift overall peak demand as desired [109]. Installing smart home appliances, which communicate with the distribution network via sensors, allows automatic response to these dynamic price signals [110]. As these automated energy networks become commercially viable, the possibilities of integrating plug-in hybrid electric vehicles (PHEVs) and other innovative devices increase [27,28,34,111–113]. Additional technical functionality, therefore, increases the number of smart sensing and optimization tools at the disposal of local energy system operators to facilitate demandside participation [46]. 2.3.3. Technology-enabled consumer participation and consumption psychology As smart technologies permeate the energy sector, the rise in demand-side participation entails opening-up of communication channels between energy consumers and the energy utility [114]. The two-way exchange of energy and information through smart metering infrastructure, dynamic price signals and networked operation of household appliances and electric vehicles (EVs) requires a heightened understanding of technology implications on consumer response and behavioral patterns [43,49,115]. As more smart devices become 'proven technologies' their commercialization is affected by end user perceptions, suggesting a deeper study of socio-psychological and philosophical aspects of energy consumption behaviors [42,45,46,48,116,117]. These research implications also inform policy questions on the sources of capital investments in smart technologies [40], and appropriate consumer technology standards that retain site and context-specificity of designs given the influence of climatic and consumer characteristics on energy consumption [39]. These in turn inform the commercial and societal consequences of new energy technologies as they relate to sustainable energy consumption [118,119]. 3. Interdisciplinary discussion of socio-technical dynamics The discussion of DES technology configurations offers two general insights. First, it shows the evolution of DES from DG to MG to SMG, with each subsequent configuration overcoming the shortcomings in the previous one. It should be noted, however, that this continuum of technical sophistication does not suggest the practicality of one technical configuration over another, and does not detract from the technical, financial and institutional contexts which dictate their relative feasibility and applicability. Nevertheless, framing the literature on DES in this manner allows other technology configurations – like virtual power plants, hybrid energy systems etc., not considered in the review – to be organized on this continuum to assist an interdisciplinary understanding of the impacts of and from technological improvements. Second, the discussion considers in parallel the social and institutional implications of DES technology evolution. This conveys the underpinning interdisciplinary discourses pertaining to local energy systems and presents the evolution of social and institutional perspectives of DES. The technical and social dynamics of DES are summarized in the interaction map are shown in Fig. 2. The technical and social perspectives on each technology configuration – before intervention and thereafter – are described in terms of their causes and effects. The pre-intervention technical and social dynamics represent the causes that justify the realization of each technology configuration – introduced in the map as an intervention whereas the post-intervention social and technical dynamics outline their implications that lead to further improvements in technological sophistication. In summary, increasing affordability of RET increases their cost competiveness and encourages their uptake as awareness among the general population continues to rise (arrow 1). This increase in the uptake of RET like solar PV and solar thermal systems renders Distributed Generation as a valid technical intervention (arrow 2) for local energy infrastructure. Through DG, consumers avail the opportunity to produce their own energy and become prosumers (arrow 3). As prosumers increase, so does the challenge of twoway energy management on the grid due to intermittence of RET (arrow 4), leading to a preference for aggregated grid-tied operation of local energy systems via a common point-of-coupling (arrow 5, continued). Together with this technical advantage for aggregated operation of proximate DG units (arrow 6), and cost competitiveness of RET (arrow ‘a’), the impacts of ‘neighbor effects’ on increase in proximate systems help MicroGrids become feasible interventions for local energy infrastructure (arrow 7). The involvement of groups of prosumers within the local energy system through MicroGrids (arrow ‘b’), requires new models of social and commercial organization around Community MicroGrids (arrow 8). As such, the success of these models is determined by the social contracts and commercial arrangements between end users and energy utilities, as well as the need for improved energy management on the grid (arrow ‘c’). These social and commercial requirements are supported by new technologies like smart meters and accompanying changes in rate structures (arrow 9). This in turn indicates the potential for further improvement in distribution-scale energy management (arrow 10, continued) – especially with the preference for aggregated operation of dispersed DG units (arrow ‘d’). The application of smart technologies at the distribution-scale renders cross-sectorial connectivity and helps improve user–utility relationships (arrow 11). Such improvements through smart technologies convey the benefits of Smart MicroGrids as a technical configuration implemented at the distribution-scale (arrow 12). Smart MicroGrids entails conferring new roles and responsibilities to end users through new commercial organization models (arrow ‘e’), and especially as RET uptake increases and smart technologies become more affordable (arrow 13). The developments in smart technologies, which facilitate realization of these new models of engagement between users and utilities, render the multi-MicroGrid concept feasible (arrow 14) – as a precursor to the larger Smart Grid vision being sought by the Federal government. The following parallel arguments are elicited from the interdisciplinary interactions across DES technologies as illustrated in Fig. 2. Intermittent energy generation of isolated DG installations and the rise in retail energy prices both indicate the need for gridtied operation of RET through local energy utilities. From a technical perspective, grid-tied operation reduces the intermittence of renewable energy generation through interconnections with the utility grid. From a social perspective, grid-tied operation imparts further agency to energy consumers who become renewable energy producers (prosumers), as they simultaneously offset their retail energy demand by supplying energy to the grid. Aggregated operation of spatially dispersed DG installations and the positive impact of social networks on the uptake of RET both indicate the need for community-oriented local energy development strategies. From a technical perspective, community-oriented energy planning encourages aggregation of isolated DG installations into grid-tied community MG. From a social perspective, community-oriented energy planning allows for participative energy generation where energy utilities, without losing their revenue base, can engage with groups of empowered prosumers rather than individual passive customers. Desired improvements in cross-scale coordination of energy networks (i.e., distribution and transmission networks) and in consumer–utility engagement both indicate the need for incorporating ICT in community MG. From a technical standpoint, smart technologies like sensors improve the performance efficiency and controllability of the distribution networks, while optimizing them for large-scale smart grid compatibility. From a social perspective, devices like smart meters, enabling two-way communication between end users and utility, convert passive customers into informed participants in energy generation and management, thereby helping curtail unsustainable energy consumption patterns. In the next section, these parallel arguments are brought to bear on urban planning and local energy policy. 4. Implications for urban planning and policy At the outset, it is easy to see that as DES continue to gain traction with decreasing costs of RET, cities become the locations of their diffusion, implicating urban planning and policy. The parallel arguments posited above from a sociotechnical view of the literature are considered in terms of their potential implications on urban regions. The following general observations can be made: The emergence of grid-tied and community-owned energy generation systems, which entails expansion in the role of consumers in a traditionally private or public sector, offers opportunities to advance participative formats of energy governance [118]. These formats channelize consumer conscious energy conservation, encourage self-regulatory practices, and retain the role of utilities, but as facilitators of community-led energy transitions. The criticality of consumers in the process of energy systems transformation [48,50] offers opportunities to empower communities, through education, training, and by providing avenues for social organization around energy-related concerns and concepts [118,120]. These steps require de-commodification of energy [46,121] and institutionalization of consumer participation in local energy generation and management [102]. Well managed local energy systems transformation implicates other local infrastructure services like water, housing and transportation, as well as regional energy planning, contributing to the dependability of the grid by eliciting ground-up engagement in energy generation and management. Distribution-scale energy generation and management also helps realize local and regional synergies for sustainable and resilient urban development (see [92] for examples). In light of these observations, the role of planning for climate change mitigation to abate carbon emissions and for climate change adaptation to promote urban resilience is worth discussing. Table 2 summarizes the planning and policy goals and actions that local governments and planners can take towards climate change mitigation and adaptation based on the following discussion. 4.1. Energy planning for climate change mitigation On-site renewable energy generation has tremendous carbon abatement potential critical for reconceiving energy intensive sectors like buildings and transport. However, energy planning is rarely an isolated endeavor and entails complex linkages to other public services [61]. This invokes the need for integrated spatial and social planning that reconciles the structural underpinnings of different urban infrastructures – from transport to housing to energy – in order to explicate hidden synergies [118,121]. This, in part, is afforded by institutional restructure [45,122] and also by land use, physical planning and urban design [59,62,123].

#### Extinction from EMP and solar storms

MM 15, [Microgrid Media, Grid Will Not Survive Inevitable Geomagnetic Storm or EMP Attack, September 15, microgridmedia.com/grid-will-not-survive-geomagnetic-storm-or-emp-attack/]

But as former Director of Central Intelligence James Woolsey warned in his recent congressional testimony, “The EMP threat is as real as the Sun and as inevitable as a solar flare.”

The Congressional EMP Commission, called it “one of a small number of threats that has the potential to hold our society seriously at risk” and “is capable of causing catastrophe for the nation.” These are not one commissions findings, but represent a consensus from studies by the Congressional Strategic Posture Commission, the National Academy of Sciences, the Department of Energy, the National Intelligence Council, a U.S. Federal Energy Regulatory Commission report coordinated with the Department of Defense and Oak Ridge National Laboratory, and numerous other reports.

With such overwhelming political and scientific consensus, it may come as a shock that nothing has been done to protect America from a power outage that could last several years. You may also be surprised that your energy bill could be paying the lobby efforts to keep it that way.

The Hundred Year Geomagnetic Solar Storm The worst disasters are often the result of natural events which occur less than every hundred years. The hundred year earthquake doesn’t remind us to build away from fault lines. The hundred year tsunami doesn’t remind us to build nuclear reactors above the inundation zone. Likewise, the hundred year solar storm did not remind us to build an electric grid capable of surviving it. Solar storms, or Geomagnetic Disturbances (GMD) are the result of a solar wind shock wave or a magnetic cloud interacting with the earth’s magnetic field. While solar storms happen as frequently as northern lights, experts are most concerned about a rare solar super-storm, like the 1921 Railroad Storm. The National Academy of Sciences estimates that if the Railroad Storm were to occur today, there would be a nationwide blackout for 4-10 years. The most powerful geomagnetic storm on record is the 1859 Carrington Event. Estimates are that Carrington was about 10 times more powerful than the 1921 Railroad Storm and 100 times more powerful than anything the modern grid has experienced. The Carrington Event was a worldwide phenomenon, causing forest fires from flaring telegraph lines, burning telegraph stations, and destroying the freshly laid telegraph cable at the bottom of the Atlantic Ocean.

According to Woolsey, a solar super-storm like the Carrington Event today would “collapse electric grids and life-sustaining critical infrastructures worldwide, putting at risk the lives of billions.”

A Close Call

In July 2014, NASA reported that Earth narrowly escaped another Carrington Event. Indeed, a Carrington-class coronal mass ejection crossed the path of the Earth, missing our planet by just three days. NASA assessment is that the resulting storm would have been catastrophic.

We are overdue for a hundred-year solar storm like the Carrington Event. NASA puts the likelihood of such a geomagnetic super-storm at 12 percent per decade, virtually guaranteeing that if we don’t experience a catastrophic geomagnetic super-storm, our children will. In his congressional testimony, Dr. Richard Garwin of the IBM Thomas J. Watson Research Center emphasized that “a once-per-century event could occur next week,” urging action to reduce the impact on the bulk power system.

Weaponized Electromagnetic Pulse (EMP)

If the threat of a natural geomagnetic super-storm wasn’t enough, the electric grid is equally fragile to an electromagnetic pulse attack. There are ways in which an EMP threat is more serious than a conventional nuke threat. Deterrence may not work at all because we may not know where the pulse came from. If everything goes dark, it could be a solar event or it could be North Korea. It could be launched from a freighter off one of our coasts or from a northern satellite designed to go unnoticed. We may never know.

“An EMP attack is one of a small number of threats that has the potential to hold our society seriously at risk” and “Is capable of causing catastrophe for the nation.” — Congressional EMP Commission

“We talk a lot about a Nuclear Bomb in Manhattan, and we talk about a cyber-security threat to the grid in the Northeast. All these things would probably pale in comparison to the devastation that an EMP attack could put on Americans” — James Woolsey, Former Director of Central Intelligence

How Likely is an Electromagnetic Pulse Attack?

EMP nuclear attacks are an open part of cyber warfare doctrine in several countries.

Russian General Vladimir Slipchenko, in his military textbook ‘No Contact Wars’ describes the combined use of cyber viruses and hacking, physical attacks, non-nuclear EMP weapons, and ultimately nuclear EMP attack against electric grids and critical infrastructures as a new way of warfare that is the greatest Revolution in Military Affairs (RMA) in history. Like Nazi Germany’s Blitzkrieg (“Lightning War”) Strategy that coordinated airpower, armor, and mobile infantry to achieve strategic and technological surprise that nearly defeated the Allies in World War II, the New Blitzkrieg is, literally and figuratively an electronic “Lightning War” so potentially decisive in its effects that an entire civilization could be overthrown in hours. According to Slipchenko, EMP and the new RMA renders obsolete modern armies, navies and air forces. For the first time in history, small nations or even non-state actors can humble the most advanced nations on Earth.

China’s military doctrine sounds an identical theme. According to People’s Liberation Army textbook World War, the Third World War–Total Information Warfare, written by Shen Weiguang (allegedly the inventor of Information Warfare), “Therefore, China should focus on measures to counter computer viruses, nuclear electromagnetic pulse…and quickly achieve breakthroughs in those technologies…”

Iran in a recently translated military textbook endorses the theories of Russian General Slipchenko and the potentially decisive effects of nuclear EMP attack some 20 times. An Iranian political-military journal, in an article entitled “Electronics To Determine Fate Of Future Wars,” states that the key to defeating the United States is EMP attack and that, “If the world’s industrial countries fail to devise effective ways to defend themselves against dangerous electronic assaults, then they will disintegrate within a few years… American soldiers would not be able to find food to eat nor would they be able to fire a single shot.”

North Korea appears to have practiced the military doctrines described above against the United States–including by simulating a nuclear EMP attack against the U.S. mainland. Following North Korea’s third illegal nuclear test in February 2013, North Korean dictator Kim Jong-Un repeatedly threatened to make nuclear missile strikes against the U.S. and its allies. In what was the worst ever nuclear crisis with North Korea, that lasted months, the U.S. responded by beefing-up National Missile Defenses and flying B-2 bombers in exercises just outside the Demilitarized Zone to deter North Korea. On April 9, 2013, North Korea’s KSM-3 satellite orbited over the U.S. from a south polar trajectory, that evades U.S. early warning radars and National Missile Defenses, at the near optimum altitude and location to place an EMP field over all 48 contiguous United States.

Recently, a North Korean vessel was disrupted in Panama carrying missiles that would have been capable of carrying out an EMP attack off the coast of America. When approached out of suspicion of drug smuggling, they resisted and the captain attempted suicide. Why Hasn’t Anything Been Done? At least five US Government studies have concluded that the threat of an EMP attack is real and needs to be acted upon, but alarmingly little has been done. NERC has prevented states from taking action and kept acts bottled up and not able to be passed by congress. Texas State Senator Bob Hall, a former USAF Colonel and himself an EMP expert, has called the lobby efforts of the electric utilities in this matter as “equivalent to treason.” “As a Texas State Senator who tried in the 2015 legislative session to get a bill passed to harden the Texas grid against an EMP attack or nature’s GMD, I learned first hand the strong control the electric power company lobby has on elected officials.” What Can Be Done To Protect Critical Infrastructure?

There is a lot that can be done to harden the grid, ranging from fast warning systems to hardening the trains that deliver coal. The grid may become more secure by trends already happening with distributed renewable energy and microgrids. Long run lines, such as the electric grid are the most vulnerable to an EMP or geomagnetic storm. “Microgrids are an important part of the solution,” said Dr. George H Baker of Resilient Societies. Reminding us that microgrids can be relatively large.

For example, my own city, Harrisonburg, has the capability to isolate itself from the grid and run critical services on local gas-turbine generators.

The bulk power system in the United States is reliable but not resilient. Like most systems, the way to be resilient is by having a robust, decentralized network with built in flexibility. Although it’s not what electric utilities want to hear, Americans will remain at risk until communities can meet all critical loads without the bulk power system.

#### Infrastructure resilience stops extinction

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

Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 89 3.1 Current risks 3.1.5 Global System Collapse Global system collapse is defined here as either an economic or societal collapse on the global scale. There is no precise definition of a system collapse. The term has been used to describe a broad range of bad economic conditions, ranging from a severe, prolonged depression with high bankruptcy rates and high unemployment, to a breakdown in normal commerce caused by hyperinflation, or even an economically-caused sharp increase in the death rate and perhaps even a decline in population. 310 Often economic collapse is accompanied by social chaos, civil unrest and sometimes a breakdown of law and order. Societal collapse usually refers to the fall or disintegration of human societies, often along with their life support systems. It broadly includes both quite abrupt societal failures typified by collapses, and more extended gradual declines of superpowers. Here only the former is included. 3.1.5.1 Expected impact The world economic and political system is made up of many actors with many objectives and many links between them. Such intricate, interconnected systems are subject to unexpected system-wide failures due to the structure of the network311 – even if each component of the network is reliable. This gives rise to systemic risk: systemic risk occurs when parts that individually may function well become vulnerable when connected as a system to a self-reinforcing joint risk that can spread from part to part (contagion), potentially affecting the entire system and possibly spilling over to related outside systems.312 Such effects have been observed in such diverse areas as ecology,313 finance314 and critical infrastructure315 (such as power grids). They are characterised by the possibility that a small internal or external disruption could cause a highly non-linear effect,316 including a cascading failure that infects the whole system,317 as in the 2008-2009 financial crisis. The possibility of collapse becomes more acute when several independent networks depend on each other, as is increasingly the case (water supply, transport, fuel and power stations are strongly coupled, for instance).318 This dependence links social and technological systems as well.319 This trend is likely to be intensified by continuing globalisation,320 while global governance and regulatory mechanisms seem inadequate to address the issue.321 This is possibly because the tension between resilience and efficiency 322 can even exacerbate the problem.323 Many triggers could start such a failure cascade, such as the infrastructure damage wrought by a coronal mass ejection,324 an ongoing cyber conflict, or a milder form of some of the risks presented in the rest of the paper. Indeed the main risk factor with global systems collapse is as something which may exacerbate some of the other risks in this paper, or as a trigger. But a simple global systems collapse still poses risks on its own. The productivity of modern societies is largely dependent on the careful matching of different types of capital 325 (social, technological, natural...) with each other. If this matching is disrupted, this could trigger a “social collapse” far out of proportion to the initial disruption.326 States and institutions have collapsed in the past for seemingly minor systemic reasons. 327 And institutional collapses can create knock-on effects, such as the descent of formerly prosperous states to much more impoverished and destabilising entities.328 Such processes could trigger damage on a large scale if they weaken global political and economic systems to such an extent that secondary effects (such as conflict or starvation) could cause great death and suffering. 3.1.5.2 Probability disaggregation Five important factors in estimating the probabilities of various impacts: 1. Whether global system collapse will trigger subsequent collapses or fragility in other areas. 2. What the true trade-off is between efficiency and resilience. 3. Whether effective regulation and resilience can be developed. 4. Whether an external disruption will trigger a collapse. 5. Whether an internal event will trigger a collapse. 1. Increased global coordination and cooperation may allow effective regulatory responses, but it also causes the integration of many different aspects of today’s world, likely increasing systemic risk. 2. Systemic risk is only gradually becoming understood, and further research is needed, especially when it comes to actually reducing systemic risk. 3. Since systemic risk is risk in the entire system, rather than in any individual component of it, only institutions with overall views and effects can tackle it. But regulating systemic risk is a new and uncertain task. 4. Building resilience – the ability of system components to survive shocks – should reduce systemic risk. 5. Fragile systems are often built because they are more efficient than robust systems, and hence more profitable. 6. General mitigation efforts should involve features that are disconnected from the standard system, and thus should remain able to continue being of use if the main system collapses 7. A system collapse could spread to other areas, infecting previously untouched systems (as the subprime mortgage crisis affected the world financial system, economy, and ultimately its political system). 8. The system collapse may lead to increased fragility in areas that it does not directly damage, making them vulnerable to subsequent shocks. 9. A collapse that spread to government institutions would undermine the possibilities of combating the collapse. 10. A natural ecosystem collapse could be a cause or consequence of a collapse in humanity’s institutions. 11. Economic collapse is an obvious and visible way in which system collapse could cause a lot of damage. 12. In order to cause mass casualties, a system collapse would need to cause major disruptions to the world’s political and economic system. 13. If the current world system collapses, there is a risk of casualties through loss of trade, poverty, wars and increased fragility. 14. It is not obvious that the world’s institutions and systems can be put together again after a collapse; they may be stuck in a suboptimal equilibrium. 15. Power grids are often analysed as possible candidates for system collapse, and they are becoming more integrated. 16. The world’s financial systems have already caused a system collapse, and they are still growing more integrated. 17. The world’s economies are also getting integrated, spreading recessions across national boundaries. 18. The world’s political and legal systems are becoming more closely integrated as well. Any risk has not been extensively researched yet, and there remain strong obstacles (mainly at the nation state level) slowing down this form of integration. 19. The politics of the post-system collapse world will be important in formulating an effective response instead of an indifferent or counterproductive one. 20. System collapses can be triggered internally by very small events, without an apparent cause. 21. External disruptions can trigger the collapse of an already fragile system. 22. The trade-off between efficiency and resilience is a key source of fragility in a world economy built around maximising efficiency. 23. Climate change, mass movements of animals and agricultural mono-cultures are interlinking ecosystems with each other and with human institutions. 24. There is a lot of uncertainty about systemic risk, especially in the interactions between different fragilities that would not be sufficient to cause a collapse on their own.

#### Pricing innovation solves existential public works without hyperinflation

Searle 22, [CEO, Technology Entrepreneur at The Searle Group, LLC, FUTURISTIC ECONOMICS FOR THE 21ST CENTURY? Robert Searle, March 12, https://wiki.p2pfoundation.net/Transfinancial\_Economics]

1. Nationwide Electronic/Digital Price Controls

Essentially, Transfinancial Economics or TFE believes that new unearned repayable and non-repayable money can be digitally created ex nihilo and phased into the economy safely without leading to uncontrolled levels of inflation or indeed hyperinflation. This is simply done with the aid of highly flexible electronic or digital price controls used for nearly every kind of financial transaction in real time. Thus, if there is a concern about some rise in the prices of certain goods and services these could be digitally capped temporarily. This would be an instantaneous process and could occur automatically, if necessary, in any part of the economy. This could be undertaken with the help of supercomputers or more likely by quantum computers (Clegg, 2021).

Of course, such digital price controls are not the ideal way of doing things but they are better than nothing. Some form of compensation could be created for retailers if desired. However, it must be stressed here that with the right algorithms the market price is allowed to change naturally as much as possible. Whether we like it or not most of the money exists as digital data in a bank. It is used in any number of transaction but “real” money like cash and coin can still be used (unmonitored or possibly monitored in some way) but it would make up only a tiny fraction of the overall economy, and hence, would have near zero significance in our understanding of the whole economy. This is an important but basic point to understand.

Also, in connection notably with vital climate change projects a legally binding agreement should ideally be undertaken to use certain algorithms to track funding. They could detect and instantly “freeze” in real-time any money that may be involved in fraud.

2. Big Data and the Real-Time Economics or the Uncloaking of the “Invisible Hand”.

As one might well realize it would be possible to understand the entire economy in real-time (or near real-time). This colossal accounting data would be created 24/7 with virtually every transaction notably using barcodes, or something similar. The central Inflation Authority would be programmed to instantly check the inflation status of each product or service and if at all necessary instant temporary price capping may occur. Hence, a huge picture of the economy would be possible and could prove invaluable for future economists. Also, such incoming real-time economic indicators would be totally up to date and as such would have no long-time lags unlike conventional economic data.

In spite of this though such information cannot fully rule out uncertainty in the economy. Yet, the data emerging instantaneously should at least give us a far better idea of how it is “working” and this could be important for decision-making. AI or Artificial Intelligence could also play a vital role in all this. Apart from identified transaction data there are what are referred to as Faster Indicators. These use various types of economic activity to be factored in to give us an even wider understanding of the economy in real time (Salina, 2020; Haldane, 2018).

It must be made clear that what we have been saying so far is a capitalist economy. TFE though can also be adapted into a socialist or communist type of economy because it can notably make central planning a lot easier and more likely to succeed unlike conventional economics. Indeed, Cybernetic Economics is an example of this kind of approach, and it is also possible in some future time to have an economy which is “completely” automated and where money is no longer necessary (Cockshott & Cottrell, 1993).

The concepts of TFE are like those proposed by Clifford Douglas and his Social Credit Movement but they have the added dimension of using Big Data and instant digital price capping which did not exist in his time. If he were around today, he would have been impressed by the use of computers, smart phones, plastic cards, et al in developing a futuristic economy. Modern Monetary Theory or MMT is to some extent similar. It should be added too that the term “Social Credit” has nothing to do with the dystopian system of the same name in China (Heydorn, 2014).

Finally in this section of this brief paper it should be said that in time the financial industry will hopefully be powered more and more by sustainable (non-fossil fuel) electricity, and it should be said too that it is possible to have a high degree of commercial confidentiality in connection with the digital transaction data instantaneously going to the Inflation Authority 24/7 for specific businesses of one kind, or another.

3. Maintaining the Value of Money in Real-Time

TFE would be able to maintain the value of money in real-time at the point of sale (POS). For example, person T buys product A in a shop and its retail price is instantly checked for its inflation status. It is found to be above the inflation rate by 50p and the customer though has already spent this amount but is compensated for it digitally by having it recreated into his or her account. This is called Above Inflation Adjustment. In another instance, person T buys product C which is 30p below the inflation rate and it is the retailer who gets the extra 30p by a digital recreation of it in her or her account. This is called Below Inflation Adjustment. (McDermott,2004).

4. Dynamic Pricing in Real-Time

Fintech is short for Financial Technology. It is a critical part of the TFE paradigm without which it cannot exist. A good example of such financial technology which exists now is Dynamic Pricing. Essentially, it can automatically deal with variable pricing due to changes in supply and demand. It has been successfully utilised in areas such as transportation, hospitality, professional sports, retail, and the like. Even Amazon uses it along with many other companies (Sharda, 2018). All this adds greater credibility to the idea of developing a genuine real-time economy on a national and ultimately international scale. Of course, it has to be realized and remembered that real-time data is used by financial markets around the world in which investors can keep an eye on the value of their shares, or securities. Traders can use such information to make “bets” on the rise and fall of prices of the various companies such as Apple, Google, Unilever, and many other lesser-known ones.

5. TFE and the Climate Change Emergency

At present the greatest challenge facing humanity is the climate change emergency. Tragically, it seems highly likely that it will become irreversible (if it is not already). As such governments, Bigtech companies, and smaller businesses must try if possible to make serious efforts to create credible resilient adaption and mitigation projects on a scale never before known in human history. All this ultimately costs money. Hence, TFE. With this emerging paradigm it would be possible to create new money to fund credible and “feasible” green projects. Of course, investors could be invited to invest venture capital into such investments which could prove lucrative. Such projects may seem in some cases more like “science fiction” but now is the time to think outside the box otherwise we could see the global demise of the human race. It is simple as that. Climate change emergency is not just a physical challenge it is also a spiritual one of the highest order.

Here are a few examples of potential green projects which need to be undertaken (though some of them are in the making or have already been done but not on a scale ultimately necessary for human survival) and they include more solar and wind and solar power facilities; more factory plants and mechanical trees to suck carbon emissions out of the atmosphere; more electric cars; more advances in Nanotechnology in which atomic structures could create new materials in a world of limited resources; possible underground cities and even underground agriculture may be a required to some extent; natural solutions; sun dimming which may be necessary but a controversial move; more flood defences; more recycling centres and so on. At the sametime with all this going on the likes of entrepreneurs such as Bezos and Musk can “wisely” continue with the possible colonisation of the moon and even mars (Gates, 2002; Carney, 2021).

6. The Basic Differences between Transfinancial Economics and Modern Monetary Theory

Modern Monetary Theory is at the time of writing been in the public spotlight for several years and has attracted much public attention. It is similar to Transfinancial Economics or TFE. MMT claims that the government is the sole issuer of the national currency and can fund public expenditure and only raises taxation, if necessary, as a means of controlling inflation at some future date. In this respect, TFE is in agreement. Infact, something like MMT already exists. It is called Deficit Spending. This is when governments need more money and can borrow it and (or) create new amounts of it (Kelton, 2020). This of course works but only to a limited extent. Now, the key differences are:

a) TFE uses digital price controls to monitor and if necessary, cap the market price. These would cover the entire economy and not just tiny sections of it. MMT though would use taxation to control inflation instead but may ultimately use price controls.

b) Unlike MMT TFE has a very advanced understanding of the economy via Big Data in real-time whilst the former would probably largely rely on old outdated understanding of economics.

c) As MMT continues to create new money into the economy a point may be reached that too much money will circulate and could lead to not just gradual rises in inflation but to a sudden mass catastrophic state of hyperinflation. With TFE such problems are dealt with directly by digital controls that would instantaneously control the situation at a touch of a button or indeed happen automatically.

#### Hyperinflation causes extinction

**Cochrane 20**, [John Cochrane is a senior fellow at the Hoover Institution at Stanford University and distinguished senior fellow at Chicago Booth, “Debt still matters,” Chicago Booth Review, 11-12-2020, https://review.chicagobooth.edu/economics/2020/article/debt-still-matters]

The notion that **debt matters**, that spending **must be financed sooner or later** by **taxes** on someone, and that those taxes will be **economically destructive**, has vanished from Washington discourse on both sides of the aisle. The COVID-19 response resembles a sequence of million-dollar bets by non–socially distanced drunks at a secretly reopened bar: “I’ll spend a trillion dollars!” “No, I’ll spend two trillion dollars!” That anyone has to pay for this is unmentioned. And who is to blame the politicians for acting this way, really? Markets offer 1 percent long-term interest rates—negative in real terms. Blowout spending financed by the Fed printing money—which is no different from debt—has resulted in no inflation so far. In the face of the deep concerns of current voters, worry that our children and grandchildren might have to pay off debt is not particularly salient. They’re either in the basement playing video games or out protesting for the end of capitalism anyway. Politicians will take the cheap money as long as markets are happy to provide it. The economists, even the modern monetary theorists, envision debt issued to pay for worthy investments, or valuable spending, all undertaken with a careful green-eyeshade approach. Washington has figured out the logical conclusion of the idea that federal debt doesn’t matter, in a way these economists have not: If debt and money printing have no fiscal cost, why be careful about how you spend money? Send checks to voters. Why not? It’s costless. No boondoggle project is objectionable. Send billions to prop up dying businesses. Why not? It’s costless. Why bother fixing the post office? Send them another $25 billion. Or $100 billion. We can go further. Why should citizens have to pay back debts if the federal government does not have to do so? Bail out student loans. Bail out bankrupt state and municipal governments and their pensions. Cancel the rent. Cancel the mortgage. Why should anyone have to pay any debt if our federal government has access to a money machine? Why work? Why should the federal government not just keep printing money and sending it to us? Other countries are not so lucky as we are. Why should emerging markets pay back debt if the US does not have to? Bail them out. These are inescapable logical conclusions of the view that federal debt has no fiscal cost. If you’re uncomfortable with the end of the trip, perhaps you should revisit the assumption from which it inexorably follows. Advocates point to World War II. It is true that the US exited the war with an even greater debt-to-GDP ratio than it has today. It was not painless. Growth higher than interest rates was part of how the US managed it, but it’s not the whole story. Two bouts of inflation, in the late 1940s and in the ’70s, devalued much debt. The US ran steady primary surpluses (excluding interest costs) from the 1940s through the mid-’70s. Spending was low in the pre-entitlement economy, and the government was not totting up hundreds of trillions in unfunded promises. The war, and its spending, was over. Statutory personal taxes and actual corporate taxes were high. Financial repression and closed international capital markets kept interest rates on government bonds low, and deprived Americans of better investment opportunities—and the world’s economies of much-needed investment capital. With all that, we still had an international debt crisis in the early 1970s, prompting the abandonment of the Bretton Woods system and depreciation of the dollar. In short, the US grew out of WWII debt by not borrowing any more, by decades of fiscal probity, and by strong supply-side growth in a deregulated economy. We have none of these reassurances going forward. And this event, and the United Kingdom’s exit from Napoleonic War debt in the 1800s by starting the industrial revolution, are about the only historical examples of a semisuccessful repayment of this much debt. Otherwise, the history of large sovereign debts is one long, sorry tale of default, inflation, devaluation, and consequent financial chaos. The UK did not exit WWII debt successfully, leading to crisis after crisis, and everyone else did worse. Still, what should we be afraid of? The vision of grandchildren saddled with taxes, or even just unable to borrow more while the economy sits at its limit of, say, 200 percent debt to GDP, is indeed not a salient brake to spending. That is not the danger. The **danger** the US faces, the danger we should repeat and keep in mind, is a debt **crisis**. We **print** our own **money**, so the result may be a sharp **inflation** that **wipes away** the value of debt rather than an even more disruptive **default**, but the **consequences** will be almost **as dire**. Imagine that five or even 10 years from now we have **another crisis**, which we surely will. It might be another, **worse, pandemic**, or a **war** involving **China, Russia, or the Middle East**. Imagine the US follows its **present trends** of partisan government dysfunction, so an impeachment is going on, as well as a contested election, and militias even roam the streets of still-boarded-up cities. Add a **huge economic recession**, but **without any reform**ed spending promises. At this point, the US has, say, 150 percent debt to GDP. It **needs to borrow** another $5 trillion–**$10 trillion**, or get people to hold that much more newly printed money, to bail out once again and pay everyone’s bills for a while. It will need another $10 trillion or so to roll over short-maturity debt. At some point, bond investors **see the end** coming, as they did for Greece, and **refuse**. Not only must the US then **inflate** or **default**, but the **normal crisis-mitigation policies**—the firehouse of debt relief, bailout, and stimulus that everyone expects—are **absent**, together with our capacity for **military** or **public-health spending** to **meet the shock** that sparks the crisis. Interest rates do not signal such problems. They **never do**. **Greek** interest rates **were low right up until they weren’t**. Interest rates did not signal the inflation of the **1970s**, or the disinflation of the **’80s**. Nobody **expects** a debt crisis, or it **would have already happened**. As noted above, there is **no defined limit** to the debt-to-GDP ratio that policy makers can use for guidance. Countries can borrow a huge amount when they have a decent plan for paying it back. Countries have had debt crises at quite **low** debt-to-GDP ratios when they did **not** have a decent plan for paying it back. Debt crises come when **bondholders want to get out** before the other bondholders get out. If they see default, haircuts, default via taxation, or inflation on the horizon, they get out. **Sound long-term financial strategy matters**. We cannot tell **when** the **conflagration** will come. But we can **remove the kindling** and gasoline lying around. Reform long-term spending promises in line with long-term revenues. Reform the tax code to raise money with less damage to the economy. The Treasury and Fed should secure long-term government financing, locking in low interest rates. And spend only as if someone has to pay it back. Because someone will have to pay it back.

#### Anticompetitive functions prevent upsides, antitrust strikes a balance that’s the best of both worlds

Stucke 16 [Maurice, Professor, University of Tennessee College of Law; Co-founder, Data Competition Institute. and Ariel Ezrachi, Slaughter and May Professor of Competition Law, The University of Oxford; Director, Oxford University Centre for Competition Law and Policy. “How Pricing Bots Could Form Cartels and Make Things More Expensive”. 10/27/16. https://hbr.org/2016/10/how-pricing-bots-could-form-cartels-and-make-things-more-expensive]

How competitive is our market economy? Not as much as it ought to be. And the growth of big data threatens to make things even worse. Antitrust regulators already struggle to keep markets competitive. How will they fare in a world where intelligent pricing algorithms subtly collude with one another?

Before we get to how pricing algorithms might collude, it’s worth reviewing the state of antitrust regulation in the U.S. We are increasingly realizing the market failures and shortcomings of U.S. antitrust policy over the past 30 years. In April 2016 the White House issued an executive order and report on the state of competition in the U.S. The report identified several disturbing signs of competition’s decline since the 1970s. Competition appears to be decreasing in many economic sectors, including a decades-long decline in the number of new businesses being started and in the rate at which workers change jobs. At the same time, many industries have become more concentrated, with profits increasingly falling into the hands of fewer firms.

These concerns have been noticed by The Economist, The Atlantic, and Harvard Business School. The solution is more competition, which traditionally has meant more-robust antitrust enforcement. But ensuring competition today means looking at its next frontier: our online e-commerce environment. It means understanding the shift from competition as we know it to the era of big data and big analytics, which is radically changing our markets and competitive ecosystem.

Big data, sophisticated computer algorithms, and artificial intelligence are not inherently good or bad, but that doesn’t mean their effects on society are neutral. Their nature depends on how firms employ them, how markets are structured, and whether firms’ incentives are aligned with society’s interests. At times, big data and big analytics can promote competition and our welfare by making information more easily available and by providing access to markets.

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The Automation Age

How robotics and machine learning are changing business.

However, we cannot uncritically assume that we will always benefit. At times, technology may be used to defy competition. Take, for example, the evolution of collusion. Cartels are generally regarded in the antitrust world as no-brainers. The cartel agreement, even if unsuccessful, is typically condemned as illegal. If you fix prices, you have few if any legal defenses. In the United States, among other jurisdictions, the guilty executives are often thrown into jail.

So, what happens to cartels with the rise of pricing algorithms? Industries are migrating from the brick-and-mortar pricing environment (where store clerks once stamped prices on products) to dynamic, differential pricing where sophisticated computer algorithms rapidly calculate and update prices. Does that spell the end of cartels, or does it create new ways to collude?

Some argue the former. Cartels are often more durable than standard economic theory predicts. Why? Humans trust one another. “Collusion is more likely,” the U.S. Department of Justice noted, “if the competitors know each other well through social connections, trade associations, legitimate business contacts, or shifting employment from one company to another.” Computers do not exhibit trust. Instead, algorithms engage in cold, profit-maximizing calculations. If algorithms are less likely than humans to trust one another, maybe they’re less likely to collude, too.

However, there are other reasons to worry about algorithmic collusion. Pricing algorithms don’t have the capacity to trust. Nonetheless, by increasing the speed at which price changes are communicated, detecting any cheating or deviations, and punishing those deviations, algorithms can foster new forms of collusion that are achieved through subtler means, that do not amount to a hard-core cartel, and that are beyond the law’s reach.

We consider four scenarios in which computer algorithms may promote collusion:

The first scenario, messenger. concerns humans agreeing to collude and using computers to execute their will. One recent example involves posters sold through Amazon Marketplace. David Topkins and his coconspirators agreed to fix the prices for specific posters sold online. They adopted specific pricing algorithms that collected competitors’ pricing information. They also wrote computer code that instructed their algorithm-based software to set the posters’ prices in conformity with their illegal agreement. Under this scenario, humans collude. They use computers to assist in creating, monitoring, and policing a cartel. In the U.S. and elsewhere, they go to jail if caught.

Our second scenario, hub and spoke, is more challenging. Here we consider the use of a single pricing algorithm to determine the market price charged by numerous users. Uber illustrates this framework. Uber drivers don’t compete among themselves over price; some drivers might be willing to offer you a discount, but Uber’s algorithm determines your base fare and when, where, and for how long to impose a surcharge. This by itself is legal. But as the platform’s market power increases, this cluster of similar vertical agreements may beget a classic hub-and-spoke conspiracy, whereby the algorithm developer, as the hub, helps orchestrate industry-wide collusion, leading to higher prices.

The third scenario, the predictable agent, is even more challenging. In this new world there is no agreement among competitors. Each firm unilaterally adopts its pricing algorithm, which sets its own price. So we shift from a world where executives expressly collude in smoke-filled hotel rooms to a world where pricing algorithms act as predictable agents and continually monitor and adjust to each other’s prices and market data. The result, we explore, is algorithm-enhanced conscious parallelism — or, as we call it, tacit collusion on steroids.

Finally, in the most challenging collusion scenario, digital eye, we consider how two technological advancements can amplify tacit collusion, creating a new level of stability and scope. The first advancement involves computers’ ability to process high volumes of data in real time to achieve a God-like view of the marketplace. The second advancement concerns the increasing sophistication of algorithms as they engage in autonomous decision making and learning through experience — that is, the use of artificial intelligence. These two technological advances enable a wider, more detailed view of the market, a faster reaction time in response to competitive initiatives, and dynamic strategies achieved by “learning by doing.” Thus they can expand tacit collusion beyond price, beyond oligopolistic markets, and beyond easy detection. With our other three scenarios, we may know when something is amiss. In our last scenario, the contagion spreads to markets less susceptible to tacit collusion under the brick-and-mortar economy and beyond pricing to other competitive initiatives. In the end, with digital eye we may think the markets, driven by these technologies, are competitive. We may believe that tacit collusion in these markets isn’t even possible. And yet we’re not benefiting from this virtual competition.

The latter two scenarios, from an antitrust perspective, are troubling. Unlike humans, computers do not fear detection, possible financial penalties, or incarceration, and they do not respond in anger. The stability needed for tacit collusion is enhanced by the fact that computer algorithms are unlikely to exhibit other human biases. Human biases can always be reflected in code. But if some biases are minimized (such as loss aversion, the sunk cost fallacy, and framing effects), the algorithm will act more consistently and deliberatively than humans in quantifying the profits that are likely achievable through tacit collusion.

With the industry-wide use of computer algorithms and the resulting greater transparency of the marketplace, computers can more easily track the behavior of numerous rivals and anticipate and react to competitive threats well before any pricing change. Each firm’s algorithm determines whether it can profit by undertaking a competitive initiative. Under our scenarios, the algorithm concludes not. This is because the rivals, possessing the same technology, can quickly identify the competitive initiative and emerging threat and know when and how to retaliate. By responding quickly, the rivals deprive any would-be mavericks of the benefits of launching competitive initiatives, and thereby diminish the incentives to undertake them.

The algorithms, if similarly programmed, may better predict a rival’s response. Moreover, if the computers coalesce around a dominant strategy, each firm can detect and appreciate the type of algorithm others are using. The computers can uniformly and swiftly punish a rival’s deviations. With each algorithm sharing a common interest (profits) and common inputs (similar data), the industry-wide use of algorithms may lead to durable tacit collusion among many competitors.

These collusion scenarios are part of several anticompetitive outcomes that necessitate recalibrating our enforcement strategies. As we explore in our book Virtual Competition, big data and big analytics can enable some online sellers to engage in behavioral discrimination. We will also see the rise of a new frenemy dynamic, whereby many companies become increasingly dependent on the beneficence of the dominant superplatforms.

The future of virtual competition isn’t necessarily bleak. The transformative innovations from machine learning and big data can lower our search costs (whether we’re finding a raincoat or a parking spot), lower entry barriers, create new channels for expansion and entry, and ultimately stimulate competition. But these welfare gains aren’t automatic. Much depends on how the companies employ these technologies and whether their incentives are aligned with their customers’ and society’s interests.

Data-driven online markets will not necessarily correct themselves, nor will the anticompetitive effects be obvious. Dominant firms can be a step ahead in developing sophisticated strategies and technologies that distort the perceived competitive environment. Even with evidence that the markets aren’t behaving competitively, antitrust, while not obsolete, may prove unwieldy at times to apply. Without evidence of anticompetitive agreement or intent, an engaged competition agency will be hamstrung. So, our current antitrust laws may not deter some of the collusion scenarios we identify.

Accordingly, businesses and competition authorities must better understand how the rise of sophisticated computer algorithms and the new market reality can significantly change our paradigm of competition — either for better or for worse. We should explore new legal safeguards to promote competition in this new competitive environment. Otherwise, we will likely experience durable forms of collusion that are beyond enforcers’ reach, sophisticated forms of price discrimination, and an array of abuses by data-driven monopolies that, by controlling key platforms like smartphone operating systems, can dictate your company’s future.

#### Collusion downsides cause market collapse

Svetlova 22 [Ekaterina, Senior Lecturer in Accounting and Finance at the University of Leicester - School of Management. “AI ethics and systemic risks in finance”. 1/13/22. https://link.springer.com/article/10.1007/s43681-021-00129-1]

The use of AI in trading execution and asset management is on the rise. It is a continuation of the processes of computerisation, market automation and big data development that have been going on for decades, for example, in the hedge fund industry, high-frequency trading (HFT) or ETF firms. However, AI applications bring about some qualitative differences. In contrast to algorithms from the early days, they have the ability to develop and implement their investing and trading strategies independently of their programmers and users. In other words, AI strategies might not be based on data, rules and correlations that human investors or traders consider to be important, but can deliberate and generate new trading policies and investment rules by themselves.

For example, machine learning applications discover datasets humans would not consider relevant; for instance, a program can find out that CEOs’ tweets are more informative than annual reports, which have been the central source of information about companies until now. AI algorithms analyse social media posts, news trends and macroeconomic data presented to them in a variety of forms such as audio, pictures, maps and texts. Deep neural networks could replace human investors in analysing fundamental data provided by companies (e.g. sales, debt, profit, etc.) to recognize regularities in data (pattern recognition) and identify the most promising stocks for a portfolio and determine the size of an investment [8].Footnote2

Although most trades (ca. 80%[21]) are automated today, advanced AI techniques still drive a rather minor subset of trades and investments in financial markets [7]. Nevertheless, their development is accelerating and requires attention, also from the side of ethicists. This is because there are reasons to think that the wide use of AI could impose morally relevant systemic risks in financial markets.

The World Economic Forum [9], Financial Stability Board [7] and BaFinFootnote3 [22] as well as the growing academic literature [10,11,12, 72, 73] highlight the fact that AI applications might destabilize the financial system and make it more prone to crises in principally new ways. First, financial companies that widely apply data-driven and, thus, easily scalable business models could become new, systemically important providers. Second, systemic risks may arise when actors and their AI algorithms start following similar strategies and thus moving markets in the same direction (herding), increasing the risk of severe market disruptions. This could happen if a large number of market participants use identical or very similar AI algorithms and data sources (for example, when algorithms and data are made available by a small number of providers). Herding might also arise because technological know-how is quickly spread across markets—through transfer of employees, reverse engineering and copying of successful algorithms—propagating the use of similar tools. Third, AI applications could lead to stronger interconnectedness of human and algorithmic market participants through new types of contract and relationship [9, 72]. For example, WEF [9] envisages the possibility that AI systems autonomously learn to collude with each other. They might destabilize competition by continuously bidding against each other to achieve the highest or lowest market price for a particular stock. This behaviour could lead to “algorithmic collusion”, the situation in which algorithms learn to engage in anti-competitive behaviour, which could cause severe market swings and jeopardize other market participants and firms whose share price is affected.

More generally, financial AI applications, which are programmed to guess and outsmart each other, are based on mutual observations and are thus prone to locking in their actions, leading to herding, disastrous resonance and tail events. Hence, the interaction order of algorithms, or collective machine behaviour, becomes central to better understanding systemic risks in markets [23, 72].

#### Great power war

Liu 18, [Qian Liu is an economist based in China, The next economic crisis could cause a global conflict. Here's why, https://www.weforum.org/agenda/2018/11/the-next-economic-crisis-could-cause-a-global-conflict-heres-why/]

The response to the 2008 economic crisis has relied far too much on monetary stimulus, in the form of quantitative easing and near-zero (or even negative) interest rates, and included far too little structural reform. This means that the next crisis could come soon – and pave the way for a large-scale military conflict.

The next economic crisis is closer than you think. But what you should really worry about is what comes after: in the current social, political, and technological landscape, a prolonged economic crisis, combined with rising income inequality, could well escalate into a major global military conflict.

The 2008-09 global financial crisis almost bankrupted governments and caused systemic collapse. Policymakers managed to pull the global economy back from the brink, using massive monetary stimulus, including quantitative easing and near-zero (or even negative) interest rates.

But monetary stimulus is like an adrenaline shot to jump-start an arrested heart; it can revive the patient, but it does nothing to cure the disease. Treating a sick economy requires structural reforms, which can cover everything from financial and labor markets to tax systems, fertility patterns, and education policies.

Policymakers have utterly failed to pursue such reforms, despite promising to do so. Instead, they have remained preoccupied with politics. From Italy to Germany, forming and sustaining governments now seems to take more time than actual governing. And Greece, for example, has relied on money from international creditors to keep its head (barely) above water, rather than genuinely reforming its pension system or improving its business environment.

The lack of structural reform has meant that the unprecedented excess liquidity that central banks injected into their economies was not allocated to its most efficient uses. Instead, it raised global asset prices to levels even higher than those prevailing before 2008.

In the United States, housing prices are now 8% higher than they were at the peak of the property bubble in 2006, according to the property website Zillow. The price-to-earnings (CAPE) ratio, which measures whether stock-market prices are within a reasonable range, is now higher than it was both in 2008 and at the start of the Great Depression in 1929.

As monetary tightening reveals the vulnerabilities in the real economy, the collapse of asset-price bubbles will trigger another economic crisis – one that could be even more severe than the last, because we have built up a tolerance to our strongest macroeconomic medications. A decade of regular adrenaline shots, in the form of ultra-low interest rates and unconventional monetary policies, has severely depleted their power to stabilize and stimulate the economy.

If history is any guide, the consequences of this mistake could extend far beyond the economy. According to Harvard’s Benjamin Friedman, prolonged periods of economic distress have been characterized also by public antipathy toward minority groups or foreign countries – attitudes that can help to fuel unrest, terrorism, or even war.

For example, during the Great Depression, US President Herbert Hoover signed the 1930 Smoot-Hawley Tariff Act, intended to protect American workers and farmers from foreign competition. In the subsequent five years, global trade shrank by two-thirds. Within a decade, World War II had begun.

To be sure, WWII, like World War I, was caused by a multitude of factors; there is no standard path to war. But there is reason to believe that high levels of inequality can play a significant role in stoking conflict.

According to research by the economist Thomas Piketty, a spike in income inequality is often followed by a great crisis. Income inequality then declines for a while, before rising again, until a new peak – and a new disaster. Though causality has yet to be proven, given the limited number of data points, this correlation should not be taken lightly, especially with wealth and income inequality at historically high levels.

This is all the more worrying in view of the numerous other factors stoking social unrest and diplomatic tension, including technological disruption, a record-breaking migration crisis, anxiety over globalization, political polarization, and rising nationalism. All are symptoms of failed policies that could turn out to be trigger points for a future crisis.

Voters have good reason to be frustrated, but the emotionally appealing populists to whom they are increasingly giving their support are offering ill-advised solutions that will only make matters worse. For example, despite the world’s unprecedented interconnectedness, multilateralism is increasingly being eschewed, as countries – most notably, Donald Trump’s US – pursue unilateral, isolationist policies. Meanwhile, proxy wars are raging in Syria and Yemen.

Against this background, we must take seriously the possibility that the next economic crisis could lead to a large-scale military confrontation. By the logic of the political scientist Samuel Huntington , considering such a scenario could help us avoid it, because it would force us to take action. In this case, the key will be for policymakers to pursue the structural reforms that they have long promised, while replacing finger-pointing and antagonism with a sensible and respectful global dialogue. The alternative may well be global conflagration.

#### A well-defined procedure avoids false negatives and positives

Harrington 18 [Joseph E., Patrick T. Harker Professor Department of Business Economics & Public Policy The Wharton School, University of Pennsylvania. “Developing Competition Law for Collusion by Autonomous Artificial Agents”. 11/13/18. https://joeharrington5201922.github.io/pdf/Collusion%20and%20Autonomous%20Pricing\_18.11.13.pdf]

In sum, I believe it is possible to identify the pricing algorithm used by an AA, which would then allow determination of its legality. Whether it will prove practical to do so is an open question that can only be addressed by systematic investigation and, towards that end, a research program is described in the next sub-section to explore its feasibility. What is reassuring at this stage is that there does not appear to be any fundamental obstacle to the implementation of this legal doctrine.

A benefit from having a well-defined procedure for testing whether a pricing algorithm is lawful is that it will clarify to both managers and courts what exactly is illegal. If managers do not know when they are acting unlawfully then illegal behavior cannot be deterred. Managers would be able to determine when they are in compliance with the law by having the learning algorithm programmed to engage in periodic testing of the pricing algorithm to ensure it does not exhibit the prohibited property. When feasible, the learning algorithm could also be constrained not to use illegal pricing algorithms. Effective enforcement also requires that courts can reasonably determine when the law is violated. If the court is not effective at making such a determination then it will be prone to false negatives - thereby allowing illegal collusion to continue - and false positives - thereby interfering with competitive markets. Furthermore, even if managers know when they are violating the law, if they anticipate that the court is unable to accurately determine illegality then deterrence will again be weakened because conviction is less tied to whether or not firms are actually acting unlawfully. With a well-defined test for determining whether a pricing algorithm exhibits a prohibited property, courts could reasonably and predictably determine when the law is violated.

### 2

#### Advantage 2---Administration:

#### The plan requires enforcement research to identify prohibited pricing. FTC has the most expertise.

Harrington 18 [Joseph E., Patrick T. Harker Professor Department of Business Economics & Public Policy The Wharton School, University of Pennsylvania. “Developing Competition Law for Collusion by Autonomous Artificial Agents”. 11/13/18. https://joeharrington5201922.github.io/pdf/Collusion%20and%20Autonomous%20Pricing\_18.11.13.pdf]

Analogous to this on-going research program to restrict machine learning in order to avoid unfair discrimination, I am proposing here a research program for restricting AAs not to collude, and detecting them when they do collude. While fairness involves a single AA, collusion involves multiple interacting AAs which makes for a more challenging problem. Ensuring fairness means constraining an AA so it does not condition on certain traits of a person. Preventing collusion means constraining an AA so it does not condition its actions on how rival Firms AAs will respond to those actions in a manner that supports supracompetitive prices. An AA is "fair" if its recommendation is not dependent on, say, a persons gender. An AA is "not collusive" if its price recommendation is not dependent on rival Firms responding in a particular manner; for example, a price increase is not contingent on rival Firms subsequently matching that price, or maintaining price is not contingent on rival Firms lowering prices if price were to be reduced.

It will require the execution of a research program to properly identify appropriate sets of prohibited pricing algorithms. Here, I provide the broad outline of what such a program will entail.

Step 1: Create a simulated market setting with learning algorithms that produce collusion and competition as outcomes.84 Keep track of when competitive prices emerge and when supracompetitive prices emerge. Perform this exercise with different learning algorithms and for a variety of market conditions. (This FIrst step would also serve to shed light on how easily AAs can produce collusion and the types of markets for which collusion by AAs is likely.)

Step 2: Inspect or test the resulting pricing algorithms for the purpose of identifying those properties that are present when supracompetitive prices emerge but are not present when competitive prices emerge. Pricing algorithms with those properties will have a high likelihood ratio and thus be a candidate for the set of prohibited pricing algorithms.

Step 3: Test the effect of prohibiting a set of pricing algorithms. This would be done by re-running the learning algorithms in the simulated market setting but where the learning algorithms are constrained not to select pricing algorithms in the prohibited set. What we would want to see is that supracompetitive prices are less frequent and competitive prices are not distorted. A generally desirable property is that it is more likely that prices are lower and welfare is higher when some pricing algorithms are prohibited.85

While it is difficult to predict what this research program will produce in terms of defining a set of prohibited pricing algorithms, one candidate for inclusion are pricing algorithms that exhibit "price matching". "Price matching" refers to a Firm setting its price (or price change) equal to the price (or price change) of a rival Firm. To be clear, a prohibition on price matching would not mean that it is illegal for firms to have identical prices. Rather, firms would be prohibited from using pricing algorithms that choose a price (or a price change) to match a rival firms price (or price change). The prohibition is not on prices but rather on pricing algorithms.

Pricing algorithms with price matching may end up in the set of prohibited pricing algorithms because price matching is a feature of collusion but is not a feature of competition. Addressing the FIrst claim, there is a long history of documented episodes of collusion in which firms used price matching. Markham (1951) and Scherer (1980, chapter 6) offer some historical examples, and more recent cases include retail gasoline (Bryne and de Roos, 2017), wholesale gasoline (Andreoli-Versbach and Franck, 2015a, 2015b), and supermarkets (Seaton and Waterson, 2013). Supporting these empirical studies are theoretical analyses that show how price matching is an effective device for coordinating on higher prices (Harrington, 2017) and maintaining compliance in the setting of high prices (Lu and Wright, 2010). In sum, price matching is commonly observed as part of a collusive scheme.

At the same time, I am unaware of any theory of competition that generates price matching. In a classic oligopoly model in which firms have common costs and identical products (or symmetrically differentiated products), equilibrium has identical prices but a Firms strategy is not to match rival Firms prices. A Firm’s optimal price depends on its cost and the strength and slope of its demand (i.e., cost and demand parameters), as well as the prices of rival firms, but it does not involve price matching. In standard static oligopoly models, a Firms profit-maximizing price is increasing in a rival firms price but it is not one-for-one as in the case with price matching.86 For example, a rise in a rival Firms price of 10% may bring forth a 5% increase in a Firms price but not the 10% increase that reáects price matching. There are dynamic models of competition with learning in which a Firms price can be more sensitive to a rival Firms price than occurs under static competition. For example, suppose market (and, thereby, Firm) demand is stochastic over time and is not completely known to FIrms.87 If FIrm A receives information suggesting demand is strong, it will then raise its price. Upon observing a higher price for firm A, firm B will also raise its price because a competitor is pricing higher (and, therefore, Firm Bs demand is stronger) but also because it signals that firm A received information consistent with stronger market demand (which means stronger demand for firm B). Still, a dynamically optimal pricing rule under competition does not call for price matching.

Given that price matching is common under collusion but not under competition,

it follows that the likelihood ratio, P r(pa has price matching jpa is collusive) P r(pa has price matching jpa is competitive)

is probably high. In any case, the execution of the three-step research program will reveal which pricing algorithms should be prohibited.

Finally, let me discuss whether the proposed definition of liability is supported by existing laws in the United States. The prohibition of certain pricing algorithms would seem inconsistent with jurisprudence regarding Section 1 of the Sherman Act. Firms could be pricing according to a prohibited pricing algorithm while not having an agreement, because those algorithms were selected by AAs. However, a prohibition on certain pricing algorithms could come under Section 5 of the FTC Act which states: "Unfair methods of competition in or affecting commerce, and unfair or deceptive acts or practices in or affecting commerce, are hereby declared unlawful." The properties of pricing algorithms that result in a reward-punishment scheme supporting supracompetitive prices could be interpreted as an "unfair method of competition".

While Section 5 of the FTC Act has largely been used in cartel cases when there is an "invitation to collude" but no evidence of acceptance of that invitation (so that, in the court’s view, communications did not result in an agreement), there could be an expanded role for the FTC in having it prosecute cases of collusion by AAs.53 Pertinent to this issue, the FTC recently issued guidelines for the use of Section 5:

In deciding whether to challenge an act or practice as an unfair method of competition in violation of Section 5 on a standalone basis, the Commission adheres to the following principles: the Commission will be guided by the public policy underlying the antitrust laws, namely, the promotion of consumer welfare; the act or practice will be evaluated under a framework similar to the rule of reason, that is, an act or practice challenged by the Commission must cause, or be likely to cause, harm to competition or the competitive process, taking into account any associated cognizable efficiencies and business justifications; and the Commission is less likely to challenge an act or practice as an unfair method of competition on a standalone basis if enforcement of the Sherman Act or Clayton Act is sufficient to address the competitive harm arising from the act or practice.54

Using Section 5 to prohibit collusive pricing algorithms falls within these guidelines with the exception of the guidelines’ focus on the rule of reason. It is certainly consistent with the approach laid out here to define a set of pricing algorithms that, while not per se prohibited, is subject to the rule of reason. In that case, the FTC would have to balance any efficiency benefits from the pricing algorithm against any proclivity towards collusion. However, as discussed above, the properties that promote collusion are likely to be quite distinct from those that enhance efficiency. To what extent per se illegality or a rule of reason is appropriate depends on the outcome of the research program and what we learn about the effects of various pricing algorithms.

The FTC may then have a legal mandate and, in terms of expertise, the FTC could well be the agency most qualified to identify and prosecute collusion in online markets by AAs. In pursuing consumer protection, the FTC has had many cases involving online practices regarding privacy and data security. As noted in its 2016 Privacy & Data Security Update, the FTC has brought enforcement actions relating to "spam, social networking, behavioral advertising, pretexting, spyware, peer-to-peer file sharing, and mobile."55 Given this developed expertise for online markets and automated processes, the FTC is in a good position to build on that base of knowledge so as to define and enforce a prohibition of collusive pricing algorithms.

#### That causes algorithmic testing and enforcement tools

Lamontanaro 20 [Aleksandra, Fordham University School of Law, associate with Oved & Oved citing Ezrachi and Stucke, Competition Law Experts and Professors, Metz, and Abrantes-Metz, Law Professor and Director at Moody’s Analytics. “Bounty Hunters For Algorithmic Cartels: An Old Solution for a New Problem.” Fordham Intellectual Property, Media, and Entertainment Law Journal, Volume 30 XXX, Number 4, Article 6, pp. 1290-1300]

Ezrachi and Stucke propose to screen the digital markets for collusion.220 According to these scholars, agencies may “evaluate computerized market environments” and—if prices become unresponsive to costs or more tightly clustered across companies—“require companies to reveal the nature of their algorithms to ascertain whether these algorithms create excessive transparency or lead to interdependence.”221

To better understand what factors are indicative of algorithmic collusion and, therefore, worth exploring further, Ezrachi and Stucke encourage enforcers to begin commissioning or internally conducting experimental research of pricing algorithms.222 As part of such research, a regulatory agency would examine the available pricing algorithms and run simulations in a collusion incubator.223 The agency could test which conditions, when included or excluded from the incubator, would raise the likelihood and longevity of collusion.224 Ezrachi and Stucke admit that such an incubator is far from perfect because it is relatively static and will not reflect changes in market dynamics over time and alteration to algorithms through, for example, human intervention.225 Nevertheless, according to Ezrachi and Stucke, such experimental research will help identify which algorithmic features raise red flags and warrant further investigation.226 Such selective intervention, Ezrachi and Stucke argue, “may have more limited cost implications” than random screening and “may also limit the possible adverse effects on innovation and investment, as it is only after tacit collusion is detected that the market is subjected to a monitoring exercise.  
Professor Rosa M. Abrantes-Metz and Managing Director at Moody’s Investor Services, Albert D. Metz, go a step further by proposing that the authorities use algorithms to screen for digital cartels and other collusive, anti-competitive practices.228 Abrantes-Metz and Metz explain that the successful detection of digital collusion requires prediction or classification functions that algorithms perform seamlessly, and which are the very same functions that make algorithms so attractive to cartels in the first place.229 The pair acknowledges that simply asking algorithms to identify illegal collusion would be hopeless because lawful tacit collusion can be virtually indistinguishable from unlawful explicit collusion.230 Nevertheless, according to them, enforcers can train algorithms to identify prices that are either unresponsive to costs or tightly clustered across rival firms.231 After such red flags are raised, economists and computational experts would further analyze the algorithms at issue and data used by them.232 Abrantes-Metz and Metz emphasize the importance of economists in the process because “an empirical approach to cartel detection is not only a prediction or classification problem: there is usually a testing component.”233 The pair explains that, for effective cartel detection, it is paramount to formulate a hypothesis to be tested: “how likely is it that the observed data were generated from a collusive rather than a competitive dynamic?”234 As Abrantes-Metz and Metz note, economists have the necessary expertise to perform statistical testing and make the determination regarding the likelihood of one hypothesis over an alternate.235

To illustrate how economists can use algorithms to identify collusion, Abrantes-Metz and Metz provide an example of the work that they performed “almost two decades ago . . . with [a] compliance department of [one] company.”236 Their task was “to identify which managers [in the company] were colluding to boost [their] performance evaluations.”237 The suspicion was that conspiring managers had agreed to boost the scores they assigned among themselves while depressing the evaluations of others.238 Having the anonymized evaluation scores and other relevant data, such as practice areas and locations, the economists used “a clustering algorithm to run over all possible combinations to find groups which minimized differences within and maximized differences without . . . .”239 Ultimately, the economists “identified exactly the [] managers [that] were suspected of colluding and the year [they had] started” to do so.240

The possibility of using algorithms to screen for collusion is also addressed in the Organization for Economic Co-operation and Development’s (“OECD”) report.241 According to the OECD, a number of competition agencies have already reported using algorithms to detect bid-rigging by screening for anomalies and suspicious bidding patterns.242 For instance, algorithmic screening enabled the Korea Fair Trade Commission to detect several bid-rigging conspiracies.243 These efforts and successes point to the promise of screening as a solution to enhancing the detection of algorithmic cartels.

#### **Leveraging AI solves global AI governance. Antitrust is the best test ground and FTC is key.**

Massarotto 21 [Giovanna, Adjunct Professor University of Iowa, Research Associate UCL CBT. Ashwin Ittoo, Associate Professor, University of Liege. “Gleaning Insight from Antitrust Cases Using Machine Learning”. https://law.stanford.edu/wp-content/uploads/2021/03/Computational-Antitrust-Article-2-Gleaning-Insight-1.pdf]

I. Introduction

Big data has become a game-changer, and Artificial Intelligence (AI) models the best way to fully exploit such large amounts of data. This paper builds on the growing interest in the application of Machine Learning (ML) techniques to the legal and regulatory domains. The main innovation of our research is that it explores the application of AI to antitrust enforcement.

In recent years, the ability of AI to generate anticompetitive behavior, such as the phenomenon of algorithmic collusion and price discrimination, has been deeply investigated.1In contrast to these earlier studies of AI and antitrust, we adopt a different perspective. In particular, we are concerned with whether AI can assist antitrust enforcers in addressing the critical need for both accelerating and harmonizing globally the enforcement of antitrust principles.2

The main question our paper aims to answer is: Can AI be usefully employed by antitrust enforcement agencies? This overarching question can be decomposed into a number of sub-questions:

1) Are there pertinent characteristics that can be extracted from past antitrust cases?

2) Are there underlying patterns characterizing antitrust cases?

3) Are the issues surrounding the adoption of AI in other branches of law, such as bias in criminal law, relevant to antitrust? In other words, is antitrust a better testing ground for the adoption of AI in the legal domain?

To the best of our knowledge, our study is the first to address these questions. They are at the heart of the Assistant Attorney General’s recent speech emphasizing the need to understand the potential of cutting-edge technologies like AI and ML to advance the antitrust field.3

To address our research questions, we first created a dataset of seventy-two past antitrust cases, spanning from 2005 to 2019. Because antitrust law is jurisdiction based, we focused on the U.S. antitrust jurisdiction, which includes two antitrust agencies: the Department of Justice (DOJ) Antitrust Division and the Federal Trade Commission (FTC). These two agencies have very different powers and structure. In a first analysis, no relevant patterns were detected when using the combined decisions of both agencies. For this reason, we focused only on the FTC enforcement action in the selection of cases in our dataset. Each case is described along sixteen variables (or features), including, among others, the Industry, Type of Conduct, or Behavioral Remedies. The complete list is presented in Part III.

Then, we developed a machine learning pipeline to automatically analyze these cases, compute the similarity between them, and cluster similar cases together into well-formed, coherent groups. An important characteristic of our machine learning pipeline is that it relies on unsupervised learning (UL) algorithms, namely clustering methods, including K-Means, Bisecting K-Means and K-Modes (see Part II.B). Unlike their more popular supervised counterparts, unsupervised approaches operate with minimal human monitoring and intervention. In addition, we performed extensive analysis of each cluster of similar cases to determine which variables best characterized the various antitrust cases. This was achieved with two supervised learning algorithms, namely Random Forest and Support Vector Machines (see Part III.B).

We proceeded our investigation by interpreting the algorithms’ results from an antitrust point of view. For example, we noted that cases from the data and computer industry were generally clustered with those in the healthcare industry, suggesting that these industries raise similar antitrust concerns. The algorithm also clustered cases in which conspiracy, the most commonly detected conduct, is strictly related to exchange of information, and as a consequence,“limitation in the exchange of information,” one of the most common remedies, was recommended (see Part IV).

In summary, as our results suggest, AI and computational antitrust techniques in general can serve as a useful tool to assist competition agencies in enforcing antitrust law in the age of big data and AI. More specifically, our study investigates how ML techniques can be used to automatically discover insights from past antitrust decisions and extract underlying recurrent patterns from these decisions, as revealed in Part IV.

The idea for this paper stems from Giovanna Massarotto’s book Antitrust Settlements: How a Simple Agreement Can Drive the Economy, 4 which analyzed a relatively large volume of antitrust cases in the primary antitrust jurisdictions (the US and EU). The book put forward the idea of an ML algorithm, trained on previous antitrust cases and used for assisting antitrust enforcers in regulating markets. In this paper, we go one step further by implementing and evaluating the algorithm trained on the FTC’s cases and practices from 2005 to 2019.

This paper is structured in five Parts. Having introduced the project and aim of our paper, Part II serves as a background of 1) the FTC’s role and powers within the U.S. antitrust law enforcement framework; 2) AI and AI methods; and 3) AI and antitrust

Part III investigates the methodology used in the development of our AI model in the context of antitrust. Part III also describes how the AI model and data to build the model were selected.

Part IV analyzes the results of our AML model by assessing the adopted variables and their importance from an antitrust perspective. More specifically, we evaluate whether the variables detected by our algorithm as statistically relevant make sense. A similar analysis is conducted with respect to the clusters detected by our UL algorithm.

Part V ends with some final remarks. Our main argument is that AI cannot replace antitrust agencies such as the FTC, but it could be a valuable tool in making the work of antitrust agencies more efficient and effective in today’s fast-moving technological environment.

The 2020s have seen vast increases in investment and interest in AI and the data industry. Data is creating a variety of new opportunities for businesses, transforming markets with faster and more sophisticated technologies, including machine learning algorithms. These new data-driven markets, in turn, create new challenges for government agencies.5

Antitrust agencies are in the spotlight because they are charged with identifying and reducing monopolistic and collusive practices in cutting edge markets, where such practices might occur at scale through algorithms (e.g. algorithmic collusion).6 A question the antitrust community is asking is whether antitrust agencies are equipped with the right tools and powers to tackle the present challenges in such a fast-moving technological environment.7 Our study aims to respond to this question by building and testing an ML antitrust algorithm.

Before diving into the explanation of our ML antitrust algorithm developed in Part III, it is helpful to clarify why we focused on FTC enforcement actions, and why antitrust can be a good testing ground for future AI applications in the regulatory domain. This evaluation requires having a brief background on the role of antitrust economic regulation and the main AI techniques available.

1. Antitrust Economic Regulation U.S. antitrust enforcement action is primarily economic in nature because it occurs mostly outside of courts and it is explicitly grounded in economics.8 In the U.S., “over the last three decades the Agencies [DOJ and FTC] have resolved nearly their entire civil enforcement docket by consent decrees.”9 Specifically, more than ninety percent of civil antitrust lawsuits filed by the U.S. government (excluding mergers) are settled by means of an agreement.10This consent solution puts in place remedies agreed on by the company under investigation and the agency before or during a trial. The wide adoption of consent decrees results in a regime of minimal case law,11 leaving the same antitrust agencies and companies to regulate markets through agreed remedies enshrined in a consent decision.12 Unlike the DOJ, the FTC can settle proceedings without the need for adjudication by a court.13 Consent decrees identify certain behavioral or structural remedies based on economic analysis, which de facto imposes an economic regulatory regime.14

Because antitrust agencies are empowered to enforce competition principles in any market, antitrust is often the first type of regulation to reach a new market.15 For example, while the Federal Communication Commission (FCC) has the authority and duty to regulate the telecommunications industry specifically,16 the FTC, through Section 5 of the FTC Act, may exercise wide discretion in regulating markets generally.17 As a result, antitrust may be considered the “first arm” of government regulation because it reaches new markets for which Congress has yet to draft a more specific regulatory scheme.

In summary, FTC antitrust enforcement mechanisms resemble economic regulation because, as outlined above, the FTC enforcement action occurs mostly outside of courts and its decisions are grounded in economics. Economic concepts drive decisions on what the FTC considers anticompetitive conduct as well as the types of antitrust remedies to adopt.

2. The FTC and Section 5 of the FTC Act

In contrast to the DOJ Antitrust Division, which represents the U.S. in criminal as well as civil antitrust cases and traditionally plays a prosecuting role, the FTC is an administrative agency with regulatory powers in addition to its prosecutorial powers.18 Our study specifically focuses on FTC antitrust enforcement action under Section 5 of the FTC Act, because the FTC is the only agency with authority to enforce the FTC Act and it is not technically in charge of enforcing the Sherman Act.19

According to Section 5, the FTC has exclusive authority to regulate “unfair methods of competition . . . and unfair or deceptive acts or practices,”20 preventing individuals, partnerships, or corporations from unfairly disrupting competitive markets.21 In other words, Section 5 grants the FTC a wide range of discretion in controlling and regulating markets generally.22 Since there are almost no litigated Section 5 cases, 23 our ML algorithm was trained mainly on regulatory settlements, known as consent decrees.

The structure and powers of the FTC resemble those of many antitrust agencies all over the world. EU National Antitrust agencies are mostly administrative agencies with similar powers, although they generally enjoy less open-ended delegations of power than does the FTC. Therefore, the same or similar AI techniques that have been applied in building the ML algorithm at hand are likely to be helpful for many other agencies across the world.

#### Public sector use solves preventative forecasting and resilience, stops extinction

Yigitcanlar Mehmood and Corchado 21, [Tan Yigitcanlar 1,2,\* , Rashid Mehmood 3 and Juan M. Corchado 4,5,6, Perspective Green Artificial Intelligence: Towards an Efficient, Sustainable and Equitable Technology for Smart Cities and Futures, 1 School of Architecture and Built Environment, Queensland University of Technology, 2 George Street, Brisbane, QLD 4000, Australia 2 School of Technology, Federal University of Santa Catarina, Campus Universitario, Florianopolis, SC 88040-900, Brazil 3 High Performance Computing Center, King Abdulaziz University, Al Ehtifalat St, Jeddah 21589, Saudi Arabia; rmehmood@kau.edu.sa 4 BISITE Research Group, University of Salamanca, 37007 Salamanca, Spain; corchado@usal.es 5 Air Institute, IoT Digital Innovation Hub, 37188 Salamanca, Spain 6 Department of Electronics, Information and Communication, Faculty of Engineering, Osaka Institute of Technology, Osaka 535-8585, Japan \* Correspondence: tan.yigitcanlar@qut.edu.au or tan.yigitcanlar@ufsc.br; Tel.: +61-7-3138-2418, Sustainability 2021, 13, 8952. https://doi.org/10.3390/ su13168952]

1. Introduction: AI in the Smart City Context The second digital and fourth industrial revolutions cultivated an innovation culture for the flourishing of many technological developments and breakthroughs [1,2]. For instance, the field of artificial intelligence (AI)—defined as algorithms that mimic the cognitive functions of the human mind to make decisions without being supervised [3]— has undergone remarkable exponential growth over the last couple of decades [4]. Today, AI is undoubtedly an in-trend, disruptive technology with countless applications, and even more prospects, for all industry sectors and areas of life—ranging from health to agriculture, engineering to finance, gaming to transportation, and so on [5]. Besides this, AI is one of the fundamental drivers of the global smart city movement [6]. Smart cities are widely seen as locations whereat digital technology and data are widely applied to generate efficiencies for economic growth, quality of life, and sustainability [7]. Today, in many urban policy circles and debates, concerning smart city transformation, AI has become a subject of debate, particularly among urban policymakers and planners who search for technocentric solutions to alarming urbanization problems [8]. This popularity is due to the increasing recognition of technocentric solutions as a potential panacea to the complex and complicated urbanization challenges—ranging from quality of life to climate change, and safety and security to mobility and accessibility [9]. The effective use of big data, AI-powered smart urban technologies and platforms is predicted to benefit urban infrastructure and service efficiency, and to address or at least significantly ease these challenges [10,11]. As stated by Wang and Cao [12], technological advancements have generated an era wherein large volumes of data—i.e., big data—are collected via smart sensors deployed in cities, and are made available via various commercial and public channels. Due to the recent advances in AI techniques and ubiquitous computing, these data now feed into the services that improve quality of life, city operation systems, and the environment. In the context of cities, AI has various applications in areas that aim to create efficiencies in urban infrastructure and services [13]. The following are among the most prevalent AI-powered examples: • Automated algorithmic urban decision-making (e.g., identification and penalization of traffic offences and tax evasions through smart sensors and machine learning-based data analytics) [14]; • Automated urban infrastructure assessment (e.g., monitoring urban infrastructure health through automated aerial mapping and deep-learning characterizations) [15–17]; • Autonomous urban post-disaster reconnaissance (e.g., detecting disaster damage and impact through synergistic use of deep learning and 3D point cloud features) [18]; • Autonomous and connected urban mobility (e.g., offering increased urban mobility through shared autonomous vehicles and autonomous shuttle bus fleets) [19,20]; • Urban descriptive, diagnostic, predictive and prescriptive analytics (e.g., gathering and interpreting urban air pollution data to describe what is the pollution level, why it happened, when it may occur again, and actions to influence future desired outcomes) [21]; • Urban security, safety, rescue and maintenance robots (e.g., emergency services operating rescue robots in risky and dangerous environments, such as natural disaster events, mining accidents and building collapses and fires) [22]; • Urban service agent chatbots (e.g., offering improved customer experiences with reduced waiting times to access services in different languages related to taxation, health services, public transport, family services, job opportunities and so on) [23]. In an attempt to generate the required efficiencies and proficiencies, many governments across the globe have started to deploy various AI system initiatives at the national, state and local levels [24,25]. The following are among the most common AI-driven applications [26]: • AI process automation systems; • AI-based knowledge management software; • Chatbots/virtual agents; • Cognitive robotics and autonomous systems; • Cognitive security analytics and threat intelligence; • Identity analytics; • Intelligent digital assistants; • Predictive analytics and data visualization; • Recommendation systems; • Speech analytics. Despite the efforts made to adopt and deploy AI in the public sector, almost all of these initiatives have either struggled, failed, or lacked the adequate potential to generate ethical, responsible and sustainable solutions [27,28]. This is also the case for the smart city domain—the existing purely technocentric or algorithmic AI perspectives could not play a prominent role in smart city transformation [26]. Toronto Sidewalk, Masdar and Songdo are among the major smart city initiatives that have resulted in project cancellations or failures in living up to their smart urban future promises [29]. The main reason behind this failure is that AI system adoption practices are heavily technologically determined and reductionist in nature, and do not envisage and develop long-term, ethical, responsible and sustainable solutions [30]. Most government AI approaches have also overlooked urban, human and social complexities; subsequently, this has created conditions for new forms of societal control, and boosted inequality and marginalization among the layers of our societies [31]. Thus, the current practice of AI has generated as many constraints as prospects, where, at times, the constraints outweigh the prospects [32]. Against this backdrop, this perspective paper highlights the fundamental shortfalls in current AI system conceptualization and practice, and points to a novel approach— i.e., green AI that also accommodates green sensing—that moves away from short-term efficiency solutions to focus on a long-term ethical, responsible and sustainable AI practice that will help build sustainable urban futures for all through smart city transformation. Here, we note that, as this is a perspective piece reflecting the authors’ opinions and interpretations of the topic, the methodological approach of the paper is not systematic; rather, the paper uses the literature to support the claims and views related to AI and smart city discourses, practices, developments, trends and applications. 2. Prospects and Constraints of AI for Smart City Transformation The utilization of smart and innovative digital technologies has become a common approach to tackling urban crises—whether they are related to climate, pandemics, natural disasters or socioeconomic factors [33,34]. In recent years, advancements in AI—as one of the most prominent technologies of our time, with significant implications for our economy, society, environment and governance—have resulted in invaluable opportunities for cities to increase their infrastructural efficiencies and predictive analytic capabilities, and hence, to a degree, to improve the quality of life and sustainability in cities under the smart city brand [35]. According to Ullah et al. [36], today, AI is rapidly becoming a critical smart city element that helps in achieving necessary efficiencies and automation in order to deliver urban infrastructures, services and amenities. Especially when coupled with other smart urban technologies, AI applications—e.g., chatbots and virtual agents, cognitive robotics and autonomous systems, cognitive security analytics, expert systems, identity analytics, intelligent digital assistants, knowledge management systems, predictive analytics and data visualization, process automation systems, recommendation systems, speech analytics, threat intelligence—provide new capabilities and directions for our cities, such as building the next generation smart cities, i.e., the “Artificially Intelligent Cities” of the future [37]. There is a vast array of literature on the prospects of AI for smart cities [38]. Nonetheless, as much as creating benefits—for instance, generating operational infrastructure or service efficiencies—AI technology also involves substantial risks and disruptions for cities and citizens, through the opaque decision-making processes and the privacy violations that are related to it; e.g., automating inequality, generating algorithmic bias due to bad or limited data and training, removing or limiting human responsibility, and lacking an adequate level of transparency and accountability [39]. Additionally, in comparison to the other technologies, AI involves some unique data-related challenges that include data acquisition, the large volume and the streaming of data, heterogeneous data, complex dependencies among the data, noisy and incomplete data, distributed data storage and processing, training data, and data privacy [12]. Some examples of AI mishaps that impact society, and that also diminish public trust in the AI solutions implemented as part of smart city projects, include, but are not limited to, the following: • AI misdiagnosis of child maltreatment and the prescription of inappropriate solutions in Pittsburgh, PA, USA [40]; • Amazon’s AI recruiting tool, which took biased decisions towards women [41]; • Bias towards people of color in the decisions made by AI algorithms used in US hospitals [42]; • Clearview AI’s scandalous facial recognition image database developed with images from social media, which got hacked in 2020, leaving citizens of democratic countries with privacy threats, and citizens of autocratic regimes under a situation akin to an Orwellian nightmare [43]; • The malfunctioning of the Australian government’s automated debt recovery program, called Robodebt, resulting in a scandal, as it had unlawfully taken AUD 721M from over 400,000 Australians [44]. One of the main reasons behind the failure of AI systems relates to the development and integration stages of AI in urban and public services. Pasquinelli [45] linked the underlying issues of AI—or in broader terms, how machines learn—to the development of AI systems when operators engage in training data, learning algorithms and model application stages. In these stages, operators could encounter three types of bias, namely: • Just-world bias (e.g., a cognitive bias that assumes people get what they deserve, leading to failures in helping or feeling compassion for others or disadvantaged groups, such as poor or homeless people); • Data bias (e.g., an error caused by certain elements of data being more heavily represented or weighted than other elements, leading to wrong decisions or inequity issues—such as for women, people of color or minorities); • Algorithmic bias (e.g., a lack of fairness, originating from the output of an algorithmic system, with consequential unfavorable decisions, actions or externalities—such as a credit score algorithm denying a loan). When an AI system containing such bias is integrated with an urban or public service, the failure of the service, or dissatisfaction with the service, is inevitable [46]. The growing concern over negative AI externalities and service failures, particularly in smart cities, proves the need for more ethical and regulated AI systems [47]. Subsequently, in recent years, attempts to provide a more holistic perspective on AI have resulted in a number of new AI conceptualizations [48]. These include “responsible AI”, “ethical AI”, “explainable AI”, “sustainable AI”, “green AI” and the like, the aim of which is to ensure the ethical, transparent and accountable use of AI applications in a manner that is consistent with user expectations, organizational values, environmental conservation and societal laws and norms [49]. It is also argued that such renewed approaches to AI will help maximize the desired smart city outcomes and positive impacts for all citizens, while minimizing the negative consequences [50]. 3. The Green AI Approach for the Flourishing of Humans and the Planet The effects of human activity—e.g., unsustainable and rapidly growing populations, urbanization, industrialization and consumerism—since the industrial revolution of 1850s, and particularly during the last five decades, have taken their toll on the environment [51–53]. As presented by Hunter and Hewson [54], the most catastrophic threats humanity is facing today include the following: • Chemical pollution of the earth system, including the atmosphere and oceans; • Collapse of ecosystems and loss of biodiversity; • Decline of natural resources, particularly water; • Global warming and human-induced climate change; • Human population growth beyond the Earth’s carrying capacity; • National and global failures to understand and act preventatively on these risks; • Nuclear weapons and other weapons of mass destruction; • Pandemics of new and untreatable diseases; • Rising food insecurity and failing nutritional quality; • The advent of powerful, uncontrolled new technology. Among these threats, “national and global failure to understand and act preventatively on these risks” is the most important. This is the incapability of the governments [55] and the public [56] to understand and take actions against threats that are most likely to, or definitely, lead to a catastrophe. This issue is the root cause of the failure of AI solutions—even if they target sustainability [57]—as they are mainly used to improve business efficiency and economic productivity in our cities [58] rather than actually tackling the aforementioned global threats that are mostly anthropogenic in origin [59]. The flourishing of humankind over the last 10,000 years in the Holocene is a consequence of the planet’s beneficial conditions, that is, the perfect climate and ecosystem [60]. As such, investigating the ways in which AI can help establish conditions in which humans and the planet can thrive in the Anthropocene has been the subject of much recent scholarly work [61]. For example, Vinuesa et al. [62] explored the role of AI in achieving the UN’s sustainable development goals (SDGs). Their study found that “AI may act as an enabler on 134 targets (79%) across all SDGs, generally through a technological improvement, which may allow to overcome certain present limitations. However, 59 targets (35%, also across all SDGs) may experience a negative impact from the development of AI”. In another study, Gupta et al. [63] assessed whether AI is an enabler or an inhibitor of sustainability, measured via SDGs. Their study disclosed that “when SDGs related to Society, Economy, and Environment were analyzed, it was observed that the Environment category has the highest potential, with 93% of the targets being positively affected, whereas Society has the largest negative effect with 38% of the targets exhibiting a negative interaction with AI”. Likewise, Goranski and Tan [64] examined the role of AI in accelerating the progress of SDGs. Their investigation revealed that “AI can generate data for more intelligent targeting of intervention, reduce waste and losses in production and consumption, create new applications that will transform entire industries and professions, and provide the necessary improvements in connectivity and cost reductions that brings the benefits of the rapid pace of technological development to many people worldwide”. While AI represents an opportunity for achieving the SDGs, as stated by Dwivedi et al. [65], an AI-supported delivery of SDGs will “require significant investment from governments and industry together with collaboration at an international level to effect governance, standards and security”. Figure 1 shows the 17 SDGs. Additionally, in recent years, we have witnessed an increase in academic literature reporting the outcomes of AI technology applications for social good, and in tackling social and environmental issues [66]. The environmental areas in which AI applications are utilized range from air pollution monitoring [67] to wastewater treatment [68], from endangered species protection [69,70] to climate change detection [71], from natural disaster prediction [27] to ecosystem service assessment [72], and other applications in environmental sciences [73]. Sustainability 2021, 13, x FOR PEER REVIEW 6 of 15 prediction [27] to ecosystem service assessment [72], and other applications in environmental sciences While the existing and potential benefits of AI for the environment have been presented in the abovementioned studies, said studies also underlined the critical importancetance of addressing the risks involved. For instance, studies emphasized the critical importance of: • Being supported by the necessary regulatory insight and oversight for AI-based technologies to enable sustainable development, and avoid gaps in transparency, safety and ethical standards [62]; • Going beyond the development of AI in sectorial areas, so as to understand the impacts AI might have across societal, environmental and economic outcomes [63]; • Offering a constructive, rather than optimistic or pessimistic, outlook on AI for promoting desired sustainable outcomes [75]. The most common negative effects of AI on the environment include increases in electricity usage (computation and transmission power consumption) and the resulting carbon emissions, along with errors in critical decisions due to user and data bias [76–78]. Given that global technology uptake is growing at an exponential rate, the impact of these externalities is expected to be immense [79]. Just to give an example, cryptocurrency mining in recent years has led to increased energy consumption globally. As stated by Cuen [80], the bitcoin electricity consumption index of the University of Cambridge indicates that “bitcoin miners are expected to consume roughly 130 Terawatthours of energy (TWh), which is roughly 0.6% of global electricity consumption. This puts the bitcoin economy on par with the CO2 emissions of a small developing nation like Sri Lanka or Jordan”. These undesired externalities call for a sustainable approach to AI that adopts a greenbased technological perspective, including switching to a sustainable AI infrastructure [81–85]. In their study on the climate cost of global computation, Dobbe and Whittaker [86] made the following recommendations for tech-aware climate policy and climate-aware tech policy: • Account for the entire tech ecosystem; • Address AI’s impact on climate refugees; • Curb the use of AI to extract fossil fuels; • Integrate tech and climate policy; • Make non-energy policy a standard practice; • Mandate transparency; • Watch for rebound effects. Making AI green and sustainable, i.e., the green AI approach, requires a bias-free (besides a reasonable environmental bias or positive discrimination), inclusive, trustworthy, explainable, ethical and responsible approach to technology that aims to alleviate the developmental challenges of the planet in a sustainable way [30,87]. This approach—using AI to solve sustainability challenges and using AI in a more sustainable way—will also serve as an enabler of smart city transformation [88,89].

#### Also displaces hostile AI that cause extinction

Tiberghien Lou and Pourmalek 22, [Yves Tiberghien is professor of political science and director emeritus of the Institute of Asian Research, University of British Columbia Danielle Luo Danielle Luo is a senior analyst, international public affairs at CPP Investments. Panthea Pourmalek Panthea Pourmalek is a master of public policy and global affairs student at the University of British Columbia., Existential Gap: Digital/AI Acceleration and the Missing Global Governance Capacity, February 14, https://www.cigionline.org/articles/existential-gap-digitalai-acceleration-and-the-missing-global-governance-capacity/]

We are facing an ever-growing gap between the phenomenal acceleration of technology and of connectivity, and the human capacity to manage these trends. The gap is well-documented in the fields of finance, climate change, pandemics and nuclear risks. But the contrast between the exponential growth of disruptive technology and the lacklustre supply of governance mechanisms is starkest in the fields of digital governance and artificial intelligence (AI).

That gap becomes existential when we consider the likely future development of artificial general intelligence (AGI) (Ord 2020) or superintelligence (Bostrom 2015) that can be misaligned with human values or even the goal of ensuring the continuity of human existence. This question of the governance of life with AI may be the most essential question of our time (Tegmark 2017), but you would not know it from the current output of global governance in this field. Summarizing the judgement of many scientists in the field, Toby Ord argues that unaligned AGI is actually the number-one global existential risk for humanity, with a 10 percent chance of human extinction within 100 years. The prophesized existential threats posed by extreme and accelerated technological advancement and expansion have never been as close to reality as they are now. As noted by Yuval Noah Harari and Daniel Kahneman (2021) in a recent conversation, the task of taming and governing the digital/AI revolution is daunting. Humanity may have no slack for a mistake this time around, given the existential consequences of such a mistake.

Today, we already benefit from tremendous digital or AI innovations in e-commerce, social media and communication, home management, work, health care, education, transportation, and entertainment (West and Allen 2020). We can foresee that AI-driven algorithms may soon be able to correct human judgement flaws (or noise) caused by fatigue, irregularity, emotions and other weaknesses, afflictions that can generate variation in decisions by up to 50 percent (Kahneman, Sibony and Sunstein 2021). Within two decades, we can envisage a world with generalized deep learning and virtual reality, computer vision, contactless love, fully autonomous vehicles in most advanced and emerging economies, autonomous weapons in militaries and a dream of plenitude (Lee and Chen 2021).

Yet, today, we witness tremendous havoc created by the explosion of social anger, exacerbated by sophisticated social media algorithms, deep polarization, the return of tribal politics, the loss of agreed truths and the spread of misinformation and dangerous conspiracies, the loss of privacy, the rise of massive and uber-powerful tech companies, and massive job displacement and inequality (Bartlett 2018). Influence operations by foreign states have also amplified such social anger and polarization in many democracies, adding a degree of external threat and urgency. We also live with a world of security-driven digital decoupling between the United States and China (Ma 2021). In other words, the digital revolution is moving faster than the human capacity to cope with it, embed it within a public good-oriented framework and steer its disruptive power toward a non-destructive direction.