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#### Capitalism causes environmental extinction---depletion and waste crisis outpace technological gains.

Tony Smith 21. Professor emeritus of philosophy at Iowa State University. "The Deadly Metabolic Rift". https://againstthecurrent.org/atc211/the-deadly-metabolic-rift/

Monthly Review editor and University of Oregon professor of sociology John Bellamy Foster has written several books and numerous articles, beginning with Marx’s Ecology: Materialism and Nature (2000), exploring the relevance of classical Marxist thought to grasping today’s existential environmental crises. Co-author Brett Clark is professor of sociology and sustainability studies at the University of Utah.

A small subset of the authors’ main claims will be highlighted here.

(1) There is indeed “an existential crisis in the human relation to the earth.” (1) Over the last 10,000 years planetary conditions fluctuated within relatively narrow and stable boundaries. The entire history of settled human civilizations has unfolded in this “Holocene” period of our planet’s life.

This period has now concluded. In a number of areas crucially important to humanity, these boundaries have been (or are about to be) transgressed: climate change, ocean acidification, stratospheric ozone depletion, nitrogen and phosphorus cycles, global freshwater use, changes in land use, biodiversity loss, atmospheric aerosol loading, and chemical pollution. (244)

Human activity is the main causal factor explaining this development, leading earth scientists to refer to the new period as the “Anthropocene.”

The authors of an important study cited by Foster and Clark warn that if the upper-range of projections of global warming were to occur it “would severely challenge the viability of contemporary human societies.”(1) When we recall how little has been done to prevent increased global warming, and how y-it is only one of the numerous planetary transformations imposing comparable risks on human societies, talk of an “existential threat” is fully warranted.

(2) There is no “technological fix” for this existential crisis. The more intelligent representatives of capital do not deny that serious environmental challenges must be faced. For them, however, this is best done by working with capitalist markets and not against them.

A carbon tax on polluting firms would give companies a strong market incentive to lower their costs by using technologies requiring fewer carbon emissions. Having to purchase rights to release carbon into the atmosphere in carbon markets would supposedly have the same effect, in their view.

There are also calls for the state to support firms undertaking massive geoengineering projects, such as sending aerosols into the upper atmosphere to reflect away the sun’s rays before they increase the planet’s surface temperature. Another proposal is to install technologies capable of extracting and sequestering significant amounts of carbon from the atmosphere.

As Foster and Clark remind us, technological change in capitalism tends to develop “greener” technologies without any special spur. Over the course of the industrial revolution, for example, each succeeding generation of steam engines became “greener” over time, burning less coal per unit of output than the one before. The total amount of coal burned in England increased nonetheless. (245)

This “Jevons paradox” (named after the British political economist who first brought it to attention) is easily explained: the increase in the number of units produced overwhelmed the reduction of coal use per unit, leading to more coal being burned overall.

Is there any reason to think that introducing technologies “greener” than those employed today won’t have a similarly paradoxical result? Investors in the stock market, whose pricing of oil companies’ stocks assumes that the last drop of oil in the ground will be profitably extracted, do not seem to think so. (243-4)

Engineering Disaster

Regarding geoengineering projects, Foster and Clark repeat the warning of many scientists that such unprecedented technological experiments would almost surely have pernicious consequences as harmful as the harms they are supposed to alleviate. (278)

Further, their massive scale would leave few resources for other social needs. An infrastructure capable of handling annual throughput 70 percent larger than that handled currently by the global crude oil industry would be required, along with ridiculous quantities of water — 130 billion tons annually just to capture and store U.S. emissions. (280)

Far from being a step towards socialism (as some techno-utopians of the left hold), government funded geoengineering would simply solidify an environmental industrial complex alongside the military industrial complex, the pharmaceutical industrial complex, and other complexes of big capital. (281-2)

Finally, once again, climate change is only one way in which present environmental trends will soon “severely challenge the viability of contemporary human societies.” In all the other cases too the sorts of technologies that have been developed, and the ways they have been used, have been part of the story of how we got to the present “existential crisis.”

Unless we figure out why that has been the case and eliminate that reason, to think we will be saved by technologies is to indulge in fantasy.

(3) Capitalism is the fundamental cause of the existential crisis in the relation between humans and the earth. All living beings appropriate resources from their environment and all generate wastes back into their surroundings. For a species to successfully occupy an environmental niche, the rate at which it depletes resources from its ecosystem must correspond to the rate they are replenished, and the rate it generates wastes must be aligned with the rate wastes can be processed.

When the social forms of capitalism are in place, neither condition is met, creating the metabolic rift between human society and its environment.

Capitalist market societies are distinguished from other societies in that products generally take the form of commodities sold for a profit. Any capitalist producers who do not attempt to make as much profit as possible, as fast as possible, will find themselves losing market share to those who do, if not forced out of existence altogether.

Making as much profit as possible, as fast as possible, generally means producing and selling as many commodities as possible, as fast as possible. This accelerated temporality is in tension with the temporality of our environment; resources tend to be depleted at a faster rate than they can be replenished, and wastes generated at a faster rate than they can be processed.

From this standpoint the “Jevons Para­dox” is less a paradox than a general description of how capitalism works. Any environmental benefits from technologies using fewer natural resources or generating fewer wastes per unit of production necessarily tends to be overwhelmed by the increase in the number of commodities produced in response to the “Grow or die!” imperative so ruthlessly imposed by the demands of capital accumulation.

From Local to Global Destruction

In the early phases of capitalist development, environmental destruction was relatively localized. After a handful of centuries of global expansion, it has sucked in re­sources from the natural world and spewed out wastes on a global scale, creating a fundamental rift in the metabolic relationship between human beings and the earth that is our home.

#### Anti-trust is capitalist---competition inevitably replicates market collapse.

Richard Wolff 19 Professor Emeritus of Economics at University of Massachusetts, Amherst. Transcript from YouTube video: “Economic Update: Competition and Monopoly in Capitalism.” Democracy @ Work. December 9th, 2019. https://www.democracyatwork.info/eu\_competition\_monopoly\_in\_capitalism.

Today I'm going to devote the program to something many of you have asked me to present, to talk about, to analyze, and that is the question of monopoly. It has to do with the assertions we hear often these days that somehow our capitalist system, here in the United States and beyond, is being negatively affected because monopolies have replaced or displaced competition. The idea here is if only we can get competition back, recreate a competitive capitalism, why then the problems we face will go away. Today's program is a design to show you how and why that is not the case, to think about these things in a different way from this nice story that capitalism is basically fine; it's just the monopoly form we have to get rid of so we get back to the competition which we're all supposed to believe is wonderful and presents us with no problems to solve. So let's go, and let's do it in a systematic way.

First, it is of course easier, faced with a declining capitalism, a capitalism that's all around us with its extreme inequalities, with its instabilities – here we are, trying to cope with the effects of the Great Crash of 2008, even while we anticipate the next downturn coming down the road soon – an economic system that has shown (that is, capitalism) that it is not respectful of the natural environment; it is not, as the words now go, sustainable in a reasonable way. Yeah, we're surrounded by problems of capitalism. So it's comforting in that situation to get the idea from somewhere that this really isn't a problem of capitalism as a system but rather the problem brought in somehow from the outside – monopoly – a situation in which competition among many companies gives way in some way we're not quite sure about to a domination by one or a small handful of companies. And so the argument goes, we don't have to be critical of capitalism; we don't have to think about an alternative system. No, no, we just have to deal with this little detail, the monopoly problem. And if we can deal with that, well, we'll get back to a competition, to a competitive capitalism that is good.

There are three big mistakes involved in this way of thinking, which is nonetheless very widespread and very popular, more so now than in quite some years. First mistake: Capitalism has been wrestling with the problem of monopoly from day one. We have had repeated periods of monopoly. They have eventually led to movements, often of many people, to destroy or remove monopoly. We used to call that in America trust-busting, or antitrust. We even have a department within the Department of Justice in Washington devoted to antitrust activities. Yeah, we've been waging battles against monopoly over and over again, and you know why? Because we keep having monopolies over and over again. Google is a monopoly. Amazon is a monopoly. They're all around us: companies that have effectively no real competition. This is a problem that capitalism has always displayed. And that ought to lead you to wonder whether thinking about it as something we can do away with isn't maybe the best possible example of wishful thinking.

The second big mistake is to imagine that competition is some unmixed blessing. It never was, and it isn't today. A competitive market is a human institution. Like every other human institution, it has strengths, and flaws, and weaknesses. To think of competition as some magical perfection is a silly abnegation of your own rational capability to evaluate something. It's sort of advertising thinking. By that, I mean the advertiser tells you what's good about the product they've been told to advertise; they don't tell you what's bad about it. If you want to evaluate it, you don't talk to an advertiser because they only give you one side. The people who promote competition use advertising logic. We're not going to do that here. Competition is no unmixed blessing.

And finally, I'm going to show you that competition is itself the major cause of monopoly. So that even if we ever got back to a competitive capitalism, all that would mean is we're back in the process that produces monopoly – as it always has.

All right, so let's begin. I'm going to start with explaining how competition has all kinds of consequences that most of you, like me, don't like, don't want. It's a discussion, if you like, of competition's other side: you know, the part that the advertiser doesn't tell you about. The used-car salesman who wants you to buy that junk doesn't tell you about what happened last week in the car crash that that was part of, etc., etc.

All right, let's begin. One of the major reasons that American corporations shut down their operations in the United States and moved them to China, among other places, is because of – you guessed it – competition. They wanted to make more money than they had been before. They were afraid of other companies beating them in the competitive game, so they said wow, let's go to China, because there you can pay workers a lot less. There you don't have the same rules to obey. There they don't care that much about pollution as they do here. So we can save on all kinds of costs, and that will allow us to undercut our competitors. Yeah, one of the consequences of competition was the exodus of American companies to other parts of the world, and the enormous unemployment that resulted from it. Yeah, that was a result, among other things, of competition.

Here's another one: Capitalists, employers, seeking to compete with one another, often engage in what we call automation. They bring in machines that are cheaper to use than human laborers, and that gets them a step ahead of their competitors. Okay, if we replace people with machines, we throw those people out of work. That has an impact on them, their self-esteem, their relationship to their spouse, their relationship to their children, their relationship to alcohol – should I continue? What are the social costs of automation? They're huge. They've been documented over and over again. Competition provokes and produces automation.

Let me give you another example: Companies are competing, say, in the food business – you know, trying to get a customer like you or me to buy this kind of cereal rather than another. So they get their labs to go to work, and they discover we can replace wheat, which we used to put in our little flakes, with – Lord help us – some chemical that is cheaper than wheat. We're not going to worry about what that chemical does to your chemistry in your body because we can now lower the price of our cereal, because we're saving on wheat, and undercut the competitor. The human beings who eat this stuff will suffer, now and in the future, but competition left our producer of cereal no choice.

And in case you think I'm making some up, let me give you some concrete ones. The Boeing Corporation, the major producer of airplanes in this country, is in a crisis as a corporation. You know why? Because the 737 Max crashed a couple of times, killing hundreds of people. And you know why? It turns out they economized on safety measures, and training measures. And you know why they did that? Because they're in a very tight competition with European and other airplane manufacturers, and that leads them – as it usually does – to look to cut corners: that race for, quote, "efficiency." Yeah, it was competition that contributed to those deaths and to that problem. That's competition too. You can't whitewash this story; they're real. One of the ways Amazon beats its competition is it speeds up the work process. It has figured out ways to make people work much more intensely, using up their brains, their muscles, their nerves, in ways that cause real long-term physical damage to working people. That, too, is a result of the competitive effort.

And you know, it wasn't so long ago that children were part of the labor force. That's right, kids as young as five and six years of age. We were told they have little fingers, you see. They can be more productive than people who are adults with big fat fingers, you know – that doesn't work. And by the way, you should be grateful because poor kids are the ones we hire, and that gives their poor families more income than they would otherwise have. We heard those arguments. Competition, the companies said, required them to use the more productive, and the lower-wage, children rather than adults. So child labor was also a result of competition. It was so ugly and so troubling to so many people that finally there were movements in the United States and many other countries simply to outlaw child labor. So it became a crime for any employer to use a worker who was under 16 or 18 years of age. That was a way in which people said we are not going to allow competition among capitalists to destroy our children. They were recognizing that competition has an awful effect in what it does to children.

Well, it has many awful effects. So let's be clear: In the history of capitalism, the monopoly problem (which we're going to get to in the second half of today's program) is no worse, it's just different, from the competition problems. Capitalism goes through phases of competition and monopoly, going from one to the other, as I will explain. But we shouldn't bemoan the one in favor of the other, any more than vice-versa. These are neither of them solutions; they are both phases of the problem. And the problem is capitalism, which does its number on us both in the period when it's competitive and in the period when it's monopoly. People who want us to engage one more time in an anti-monopoly crusade are doing something that in the end evades the problem, which is the system – capitalism – not this or that form of that system, such as competition and monopoly.

We've come to the end of the first half of today's Economic Update. This gives me an opportunity to remind you, please, to sign up if you haven't already, to subscribe to our YouTube channel. It's a way easily for you to support us, doesn't cost any money, and it is a big help to us in terms of our reputation and what we can accomplish. Likewise, please make use of our websites. They are there for your communication with us. They are there for you to be able to, with a click of a mouse, to follow us on Facebook, Twitter, and Instagram. And finally, a special thanks goes, as always, to our Patreon community for their ongoing enthusiastic support. It means the world to us. My final, very final for this first half, is about a new book that we have just produced and released. It's a follow-up to an earlier volume I have spoken to you about that was called Understanding Marxism. For the same reason, we have now produced a brand-new book, just out, called Understanding Socialism. It is a response, as this program is, to issues, questions, comments you have sent to us in large numbers. It's an attempt to give an overview of the different interpretations of what socialism means, of what happened in countries like Russia and China that tried to create this – the strengths, the weaknesses, the lessons to be learned, what to do, and what not to do. Please, if you're interested and want to follow up, check us out, check the book out: lulu.com is how you find both books. And I will be right back; stay with us.

Welcome back, friends, to the second half of today's Economic Update. This program, as I explained, is devoted to the analysis of competition and monopoly as two interactive, sequential phases of capitalism as a system. The first part of the program was devoted mostly to competition, so let's turn now to monopoly. What is the basic definition and criticism of monopoly? Strictly speaking, monopoly is defined simply as a situation in which the producers of a particular commodity – shoes, software programs, haircuts, it doesn't matter – have been reduced to only one. Literally one seller – a monopolist. But in general language, it includes also situations where many producers who once competed with one another have been reduced to only a handful. The strict term for only a handful is "oligopoly," but we don't have to split hairs about this. "Monopoly" will be the word we use for either one or a very small number.

For example, there were once dozens of automobile companies, but very quickly their competition reduced them to basically three for much of the post-World War II period, and you know their names: Ford, General Motors, and Chrysler. And likewise there were once many cigarette producers, there were once many television-set producers, and they became very few, whose names, therefore, we all know.

What's the criticism of a monopoly or oligopoly situation? Again, very simple: The idea is, if there's only one seller of something, that seller can jack up the price way above what he might have otherwise because he doesn't have any competitor. If he had a competitor, if he raised the price, the competitor would get all the business because we'd all go to the competitor who hadn't raised the price rather than buy it at a higher price from the monopolist. So we don't like monopolies, because they can jack up their prices and their profits because they don't have a competitor. And if it's a few, a handful, well then we talk about things like cartels: arrangements when a few get together over dinner, or out on the golf course, and tell us what the price is. If you ever wondered why the prices of different cars, different cigarettes, and so on, are so close to one another – mm-hmm – that's because there are few sellers, and somehow they worked it all out. But the basic criticism is that a monopoly is a situation in which the seller of something jacks the price up way beyond what they could otherwise get because there are no more competitors.

So let's talk about this monopoly problem and where the monopolies come from. Well, the first and most important lesson is this: Competition produces monopoly. It's not something external, imposed on competition. It has nothing to do with human greed or anything else. Are people greedy? You betcha – some more, some less – but that's really a separate matter. It's competition that produces monopoly, and let me show you how that works. In competition, we have, by definition, a whole bunch of producers. They all produce the same thing. They compete with one another, hoping we, the consumer, will buy from one rather than the other. They compete in the quality of what they produce and in the price of what they produce. And we are supposed, as consumers, to go look for the best quality at the lowest price, and to patronize that one who offers that to us better than the others that we could buy from but choose not to.

Okay, that's a fair definition. Now let's follow the logic. Company A produces – however it manages it – a better quality and/or a lower price than Company B. So we all go to Company A. Company B can't find any buyers because it's not competitive. Or to say the same thing in other words, Company A outcompetes Company B. Here's what happens: Company B collapses. Because it can't sell its goods, we're all going to Company A. So Company B sooner or later declares bankruptcy. It can't continue. It lays off its employees, it stops buying inputs, because it can't compete. Good. Now what happens in Company A? Company A says hey, there's a whole bunch of workers that have just lost their job at Company B; they're trained in producing what we produce; let's go hire some of them. And likewise, Company A says, they're not using their computers, or their trucks, or their other inputs. They're going to have to sell them on the secondhand market. We can get some important inputs we need at a lower price than we would have to pay if we bought them new. So what begins to happen is, where before there were two companies, A and B, there's now one larger A, and B has disappeared. Or to say the same thing in simple English, A – the winner in the competitive struggle – eats, absorbs into itself, what's left of Company B.

And this process is repeated over and over, until 30, or 300, companies have become one, or two, or three. That's the result of competition. That's how competition is supposed to work. That's how competition does work. It's important to understand: Monopoly is where competition leads. And as if that weren't enough, let me make sure you understand this from the business point of view: It is the great dream of every entrepreneur to become the last one standing in the competition, to win the competition, not just because it makes you feel good you outmaneuvered your competitors, but because if you're the last one standing, you're the monopolist. The reward for having outcompeted the others is that you're now in a position to jack up the profits, and the prices, way beyond what you could have done before.

So we have a system that produces monopoly, and all the incentives for every entrepreneur in competition to work as hard as possible to become the monopolist. So why is anyone surprised that monopolies keep happening, because they're the whole point and purpose of capitalist competition. If you ever were – and we never have, but if you ever were – able to get rid of all the monopolies and re-establish competition, all you would be doing is setting this same process in motion again for the umpteenth historical time. In other words, fighting against monopoly is pointless as long as you have capitalism, because it is the endless reproducer of this problem – as it always has been.

Now, how do monopolies maintain themselves? If you're the only one standing, you're a monopolist. Or you're an oligopoly, you're a few, and you get together and jack up your prices together. The question becomes look, a monopolist makes very high profits – much higher than a competitor can achieve – and isn't that an enormous incentive for other capitalists to get in on that business? Because look at the profits they're earning, because they're the only one. Apple, Amazon, Google – the profits are staggering. Everybody wants to get in. So the way a monopolist has to think is, I've got to create obstacles that block other people from coming in to get a piece of the enormous profits my monopoly allows me to get. We call that in economics "barriers to entry." Monopolists need to create barriers. Let me give you a couple of examples.

The major soft drink makers in the United States – basically Coca-Cola and Pepsi Cola – they produce a drink that has sugar and coloring in it, and lots and lots of water. Let me assure you, there is nothing difficult or complicated about producing a mixture of sugar, color, and water. It doesn't take a genius; it never did. Pepsi and Coca-Cola make a fortune off of their product, as we know, and they have for decades. They have a virtual monopoly. Now, lots of other people could produce water, sugar, and color close to, if not identical with, whatever they produce, but they can't break through. They can't really get to that status. And you know why? Because Coca-Cola and Pepsi erected a barrier to entry. And the way they did that was with advertising. Every billboard, every magazine cover, every doorway of every institution you've ever been to has a picture of smiling, happy people drinking one or the other. You've learned: that's the drink, that's the drink. Another company might make a perfect substitute, but they can't afford the enormous cost of advertising. The advertising costs more than the water, and the sugar, and the color. What you pay for when you buy Pepsi and Coke is the advertising that got you to buy it. You're paying for being hustled. But it works, because it means other companies know that they can't get in there by cheaply producing an alternative, because you have to produce the advertising that goes with it, or else you can't do it. And so their monopoly is maintained.

Here's another way to maintain a monopoly: Get the government to step in. Here the famous example is the milk producers. Some years ago, there was a crisis with milk. There was contamination; people were getting sick. So the clever milk monopolies came in and said, we're going to support the enormously expensive, special equipment to guarantee pasteurization, and so on, of milk. Why did they support it? Because your small farmer, your small dairy producer, can't afford it, so they go out of business. Only the big, rich few that are left can afford the enormous equipment. They used governmental rules to create a barrier to entry.

Here's another way: corrupt public officials. President Trump denounces Huawei corporation because it compromises our national security. It denounces European car producers because somehow their shipping cars here compromises our security. Who cares? As long as the president blocks other companies from getting into the business that might compete with an American, a barrier to entry exists. Monopolists have been very creative in coming up with ways to preserve their monopolies.

I don't want to lose the basic point. The basic point is: Capitalism oscillates, back and forth between competition and monopoly – first this industry, then that one. For a while, Ford, General Motors, and Chrysler were the monopolies – or the oligopoly, if you like – in automobiles. But eventually, Toyota, and Nissan, and Peugeot, and Fiat broke the monopoly. In that case, it was foreigners who did it. And then we had some competition, and that, then, is now shrinking. The French – the last two producers in France – have just agreed to merge. You get the picture. Industry by industry, first this one, then that one, go through one phase or another.

The important point is: The phases are not our problem. They merge into, and incentivize, each other. Each provokes movement in the other direction. The point to understand is that the problems of a capitalist system are not about this oscillation of phases. We're not going to solve the problem of monopoly by getting rid of them and re-establishing competition. We've been there; we've done that; it reproduces monopoly; and it doesn't change the basic inequality, unsustainability, instability of capitalism. We need to get beyond that stale, old debate – competition versus monopoly – and face the underlying reality: Capitalism is the problem, and getting beyond it is the solution.

#### Vote neg to endorse global movements---pressures towards socialist state action are building, forces the hand of monopolies.

Carles MUNTANER ET AL. 15, MD, PhD, Professor in the Faculty of Nursing, Dalla Lana School of Public Health, and in the Department of Psychiatry, Faculty of Medicine, at the University of Toronto; Edwin Ng, PhD in Social Science and Health in the Dalla Lana School of Public Health; Haejoo Chung, associate professor in health policy at the Korea University College of Health Sciences; Seth J. Prins, PhD candidate in Epidemiology and a Psychiatric Epidemiology Training Program Fellow at Columbia University [“Two decades of Neo-Marxist class analysis and health inequalities: A critical reconstruction,” *Social Theory & Health*, Vol. 13, No. 3-4, Aug/Nov 2015, p. 267-287, Accessed Online through Emory Libraries]

An ostensible goal of all research on the social production of health inequalities is not merely to describe or explain such inequalities, but to effectively reduce them (Muntaner and Lynch, 2002; O'Campo and Dunn, 2011; Muntaner et al, 2012b). A Neo-Marxist class approach has implications for the way that researchers think about and engage with efforts to reduce health inequalities, implications that invert the mainstream relationship between research and action. A cursory glance at the conclusion sections of many population health studies reveals an almost rote focus on ‘policy implications’ relevant to policymakers. We argue here that, although this mainstream orientation to social class and health inequalities may appear innocuous or politically neutral, it in fact functions in the service of incremental, apolitical, technical changes that are ultimately system-justifying and status-quo-reproducing (Chomsky, 1971).

As we described at the outset, the individual attribute approach to social class tracked broader trends in social science theory and research towards reductionism and methodological individualism. This absolves researchers from engaging with social processes and relations, which demand analyses of exploitation, domination, and even employment relations. These intellectual trends, in turn, reflect structural changes in the political economy of academic institutions that produce such knowledge (Muntaner et al, 2012a). While a complete discussion of the impact of neo-liberalism on health inequalities research is beyond the scope of this analysis, we contend that such trends conform to political options that often perpetuate inequalities, because they produce knowledge that explicitly avoids the mechanisms that generate social and health inequalities.

What can a Neo-Marxist approach to social and health inequalities add? Aside from doing the opposite of the mainstream approach (that is, re-engaging with analyses of employment relations, exploitation, domination and other class processes), an important contribution of Neo-Marxist class analysis is to break the chain between health inequality research and the ‘policy mystique’. It can do this by flipping its orientation from the top-down to the bottom-up, and rediscovering and engaging with the rich diversity of poor people's and working class social movements whose struggles - class struggles - against inequality, including health inequalities, can become a target audience for research and action. Adopting a relational class approach means recognizing - not just politically, but from a pragmatic research design and implementation perspective - that the vast majority of ‘the 99 per cent’ are completely alienated from the policy space, both professionally and electorally. Examples of such bottom up class approaches would be the ‘Housing First’ program in Canadian cities (van Draanen et al, 2013) or public health action research with labour unions in the United States (Malinowski et al, 2015). A resurgence of poor, working class, and climate-justice activism, from the international outgrowths of Latin America's left turn and the Arab Spring (Muntaner et al, 2011) to the anti-austerity movements in the European Union (Tugas, 2014), provides compelling opportunities for researchers to address new, grassroots stakeholders.

Recognizing that the vast majority of the population is on the opposite side of the class struggle than 'policymakers' does not imply that we should abandon progressive health policy reforms, but it means that we should adopt a more critical, bottom-up perspective towards how policy changes affecting the public's health are ultimately achieved. This is not to say that all researchers of social inequalities in health must become public social scientists (Burawoy, 2005) but it is to say that we cannot consign ourselves, under a thin veil of neutrality, to de facto approaching policy from a privileged position of access to elites, that is, from the orientation of serving policymakers. At the very least, we should have a more class-conscious perspective (Burawoy, 2014). Returning to and advancing relational approaches to class may be the only way this will be possible.

### 1NC - OFF

FTC DA

#### Bedoya will be confirmed to the FTC now, but it’s narrow---his agenda is key to regulating facial-recognition tech.

Jessica Rich 11/18/21. Former director of the Federal Trade Commission’s (FTC) Bureau of Consumer Protection (BCP), Counsel at Kelley Drye LLP. “Some fireworks at Bedoya’s Senate confirmation hearing, but confirmation still seems likely.” Ad Law Access, 11-18-2021. https://www.adlawaccess.com/2021/11/articles/some-fireworks-at-bedoyas-senate-confirmation-hearing-but-confirmation-still-seems-likely/

On November 17, the Senate Commerce Committee held its eagerly-awaited hearing on the nomination of Alvaro Bedoya, a data privacy academic from Georgetown Law, to be FTC Commissioner. Bedoya is slated to replace Rohit Chopra, who departed the agency last month to become Director of the CFPB, and Bedoya’s appointment would once again give the Democrats a voting majority. In the run-up to his hearing, some have wondered – Can we expect Bedoya to provide Chair Khan with a reliable third vote for her agenda, or will he bring a more bipartisan approach to the agency? From his answers and demeanor at the hearing, the answer is probably…both.

First, a little table-setting: Bedoya’s nomination was considered along with three others – Jessica Rosenworcel for FCC Chair and two nominees for the Department of Commerce. The hearing was well-attended by Committee members, who directed the majority of their questions to Rosenworcel. (Yes, net neutrality, broadband access, and the “homework gap” all got more attention than privacy.) All four current FTC Commissioners attended the hearing in person, in a bipartisan show of support for Bedoya, though Bedoya attended remotely due to a recent exposure to COVID.

Here are some takeaways from Bedoya’s portion of the hearing.

He appears likely to be confirmed, even if largely along party lines. Although Senator Wicker made a reference to Bedoya’s “strident” views and Senators Lee, Cruz, and Sullivan slammed his “extremist” tweets (see below), most of the questions (from 18 Senators!) related to Bedoya’s area of expertise (privacy), where there is more alignment between the parties than in other areas. He handled the questions well, and repeatedly expressed support for collaboration and bipartisanship (e.g., specifically mentioning that he wants to work closely with Commissioner Wilson on privacy). Democrats have the votes (in the Committee and on the Senate floor), even if they ultimately have to call in V.P. Harris to break a tie.

He spoke about his nomination and the issues in personal and emotional terms. Bedoya highlighted that he and his family were welcomed into this country 34 years ago. He talked about his experience as a Senate staffer, learning about the terror and harm caused by stalking apps from a shelter for battered women. He realized then and believes now that “privacy is not just about data, it’s about people.” His goal as a Commissioner would be to make sure the FTC protects people, and to help both consumers and businesses manage the multiple crises facing the country – a COVID crisis, a privacy crisis, and a small business crisis.

He appears likely to vote with the majority on many (or most) issues. No big surprise here, but when asked his views about various issues, he consistently supported positions that Khan, Slaughter, and (his predecessor) Chopra have supported – federal privacy legislation, Magnuson-Moss privacy rulemaking if Congress doesn’t act, pushing back against the “unprecedented consolidation” that is forcing small businesses to close, streamlining the FTC’s rulemaking and subpoena processes, reducing the power of the platforms, and reining in tracking technologies like facial recognition. As to the latter, he said he would not support banning facial recognition technologies altogether, since some applications assist with benefits like public safety and healthcare. However, he would support banning facial recognition technologies that are hidden, that lack consent, or that collect, use, and share data without limits.

He’s a real-live privacy expert. He clearly has the credentials, starting with his work as a Senate staffer and continuing through his years at Georgetown Law as a professor and head of a privacy think tank. But he also quickly and confidently answered all questions related to privacy – from the need for privacy legislation generally, to his views on Senator Schatz’s “duty of loyalty” and Senator Markey’s proposal to amend COPPA, to the lines he would draw on facial recognition (see above).

He wrote some controversial tweets, and a number of Republicans seem poised to vote “no” on his confirmation. Senator Sullivan cited a tweet from Bedoya calling the 2016 Republican convention a “White Supremacist rally.” Cruz cited tweets about ICE as a “domestic surveillance agency” and a retweet involving critical race theory and white supremacy. He also called Bedoya a “left wing activist, bomb thrower, extremist, and provocateur.” Lee ran through a series of supposedly “yes or no” questions in rapid succession, and accused Bedoya of being evasive when he tried to qualify his responses. And Wicker referred to Bedoya’s “strident” views, as noted above. As to the tweets, Bedoya apologized, saying that it was “rhetoric” and that he would put aside any partisan views if he became Commissioner. However, these Senators (and perhaps other Republicans) seem poised to vote “no” on Bedoya’s confirmation, and some have said they plan to place a “hold” on the process, which could slow it down.

If confirmed, he could help reduce tensions at the Commission. With acrimony among the Commissioners currently at unprecedented levels (see our recent post here), adding Bedoya to the mix could help reduce the tensions (despite the tweets). He’s known to be collegial, he worked across the aisle as a Senate staffer, he repeatedly invoked bipartisanship at the hearing, and all of the sitting Commissioners (Democrats and Republicans) showed up at the hearing to support him. That augurs well for the dynamics at the Commission, even if the votes remain split along party lines.

We will continue to monitor progress on Bedoya’s nomination and post updates as they occur.

#### The plan triggers backlash to the FTC.

Alison Jones 20. Professor of Law at King's College London, with William E. Kovacic – George Washington University, March, “Antitrust’s Implementation Blind Side: Challenges to Major Expansion of U.S. Competition Policy.” The Antitrust Bulletin. https://journals.sagepub.com/doi/full/10.1177/0003603X20912884

D. Political Backlash

As we have already indicated, the government’s prosecution of high stakes antitrust cases often inspires defendants to lobby elected officials to rein in the enforcement agency. Targets of cases that seek to impose powerful remedies have several possible paths to encourage politicians to blunt enforcement measures. One path is to seek intervention from the President. The Assistant Attorney General of the Antitrust Division serves at the will of the President, making DOJ policy dependent on the President’s continuing support. The White House ordinarily does not guide the Antitrust Division’s selection of cases, but there have been instances in which the President pressured the Division to alter course on behalf of a defendant, and did so successfully.125

The second path is to lobby the Congress. The FTC is called an “independent” regulatory agency, but Congress interprets independence in an idiosyncratic way.126 Legislators believe independence means insulation from the executive branch, not from the legislature. The FTC is dependent on a good relationship with Congress, which controls its budget and can react with hostility, and forcefully, when it disapproves of FTC litigation—particularly where it adversely affects the interests of members’ constituents. Controversial and contested cases may consequently be derailed or muted if political support for them wanes and politicians become more sympathetic to commercial interests. The FTC’s sometimes tempestuous relationship with Congress demonstrates that political coalitions favoring bold enforcement can be volatile, unpredictable, and evanescent.127 If the FTC does not manage its relationship with Congress carefully, its litigation opponents may mobilize legislative intervention that causes ambitious enforcement measures to the founder.

Imagine, for a moment, that the DOJ and the FTC launch monopolization cases against each of the GAFA giants. Among other grounds, these cases might be premised on the theory that the firms used mergers to accumulate and protect positions of dominance. The GAFA firms have received unfavorable scrutiny from legislators from both political parties over the past few years, but the current wave of political opprobrium is unlikely to discourage the firms from bringing their formidable lobbying resources to bear upon the Congress. It would be hazardous for the enforcement agencies to assume that a sustained, well-financed lobbying campaign will be ineffective. At a minimum, the agencies would need to consider how many battles they can fight at one time, and how to foster a countervailing coalition of business interests to oppose the defendants.

#### FTC enforces the aff---empirics.

Todd Wells 16. “Exploring the Space for Antitrust Law in the Race for Space Exploration,” 15 Wash. U. Global Stud. L. Rev. 381 (2016), https://openscholarship.wustl.edu/law\_globalstudies/vol15/iss2/93. Antitrust Laws in Place Around the World

Countries around the world take a myriad of approaches to antitrust laws. The United States has a few major statutes in place to fight anticompetitive behavior: the Sherman Act,56 The Federal Trade Commission Act,57 and the Clayton Act.58 Under United States’ law, a violation of an act typically requires an overt action rather than just a company being a large company.59 Antitrust law in the United States has even been applied to private space exploration companies.60 Russia uses the Federal Antimonopoly Service to police antitrust law.”61 The most recent update resulted in a liberalization of their policy reducing the administrative barriers to certain transactions.62 Japan’s Antimonopoly Law has many similarities to US law, but as a whole is stricter than US antitrust law.63 India’s antitrust law is relatively new and less important to this discussion because this Note focuses only on Indian government efforts in space.64

There has been some push for international antitrust law to begin dealing with international antitrust issues. Because of increasing globalization, “Cooperation is fundamentally important to competition enforcement in today’s globalized world.”65 Different policies from

country to country can cause serious problems.66 This is especially true in an era in which space exploration is becoming more of a joint venture.67 The Supreme Court of the United States has considered that even with laws that look similar internationally, there is pressure to resist applying an individual country’s laws to international competition.68 The outlook for a real change in international antitrust law looks bleak.69

#### There’s precedent---2006 case.

Pranoy Goswami 20. “The offshoots of privatization of the space race: Need for an International Antitrust Regime.” *The Law Blog*. 11-2-2020. https://thelawblog.in/2020/11/02/the-offshoots-of-privatization-of-the-space-race-need-for-an-international-antitrust-regime/

Some of the most impressive antitrust laws emanate from the United States, ranging from the [Sherman Act](http://neconomides.stern.nyu.edu/networks/ShermanClaytonFTC_Acts.pdf), the [Federal Trade Commission Act](https://www.ftc.gov/enforcement/statutes/federal-trade-commission-act), and the [Clayton Act](http://euro.ecom.cmu.edu/program/law/08-732/Antitrust/ClaytonAct.pdf). Antitrust law in the United States has previously been applied in the field of private space explorations as well, with the Federal Trade Commission’s review and approval of the [October, 2006 United Launch Alliance deal](https://scholarship.law.gwu.edu/cgi/viewcontent.cgi?article=2757&context=faculty_publications) between Boeing and Lockheed Martin being a major highlight of the regime. In the case of [SpaceX v. Boeing](https://www.nasaspaceflight.com/2006/05/spacex-vs-boeing-and-lockheed-case-closed/), the Supreme Court held that “a firm must take overt action to exercise competition, before it is considered to be a violation of the law” and dismissed SpaceX’s appeal of undue influence on the part of Boeing to prevent their entry into the market.

#### That derails Bedoya’s nomination

Kathleen Murphy 21. Senior reporter at FTC Watch, 11/1/21. “Bedoya’s confirmation hearing draws closer,” FTC Watch. https://www.mlexwatch.com/articles/13940/print?section=ftcwatch

When Alvaro Bedoya, President Joe Biden’s nominee to the Federal Trade Commission, faces US senators, he will be asked about his scholarly views on privacy. But the hearing also gives senators a chance to assess the agenda of the last FTC nominee they confirmed, Chair Lina Khan.

The Senate Commerce, Science and Transportation Committee is set to consider Bedoya’s nomination, although no hearing date has been set. It’s most likely to occur the week of Nov. 15 or early December, based on the 2021 Senate calendar.

Serving on the FTC means Bedoya, a Georgetown University professor and former congressional lawyer, would end a 2-2 split and give Democrats a majority to implement the chair’s policies. Bedoya, founding director of the Center on Privacy & Technology at Georgetown Law, would replace former Commissioner Rohit Chopra who left Oct. 8 to serve as director of the Consumer Financial Protection Bureau.

Biden nominated Bedoya in mid-September. Khan, meanwhile, started serving as FTC chair in mid-June after an 83-day confirmation process. (See FTCWatch, No. 1002, March 29, 2021.)

‘99% about FTC Chair Lina Khan’

Michael Keeley, co-chair of the antitrust practice at Axinn, Veltrop & Harkrider, tweeted: “Bedoya confirmation is going to be 99% about FTC Chair Lina Khan, and 1% to do with Alvaro Bedoya. (And hopefully 0% about the Vertical Merger Guidelines.)”

Keeley said he expects the focus of the hearing to be assessing the wisdom of the policies being pursued by Khan.

“One area that might come up will be the number of steps the commission has been taking already to try to discourage mergers generally, which is consistent with the policies that were pursued and announced by the administration,” Keeley said in an interview. Confirmation hearings are useful for antitrust lawyers, Keeley said, because it’s “always good to understand the priorities that an enforcer believes in and to have them engage with senators on tough questions.”

Bedoya’s expertise

Bedoya, who is a naturalized US citizen born in Peru, has focused his work on the impact of surveillance and commercial data collection on immigrants and people of color. He has written about police use of facial recognition and oversaw the Center’s investigation that showed most American adults are enrolled in police face recognition databases that suffer from race and gender bias. Advocacy groups, such as anti-monopoly and civil rights organizations, urged the Senate to confirm Bedoya swiftly.

The antitrust views of Bedoya, a Yale Law School graduate, are less spelled out, offering another avenue of inquiry for senators. Republican senators are expected to examine how closely Bedoya will mirror the priorities Khan has established.

#### Bad facial-recognition tech causes democratic backsliding---proactive US regulation is key.

Andrea Kendall-Taylor et. al 20. Senior fellow and director of the Transatlantic Security Program at the Center for a New American Security, co-author of Democracies and Authoritarian Regimes, with Erica Frantz - Assistant Professor of Political Science at Michigan State University, and Joseph Wright - Professor of Political Science at Pennsylvania State University, March/April 2020. “The Digital Dictators,” Foreign Affairs. <https://www.foreignaffairs.com/articles/china/2020-02-06/digital-dictators>

THE CHINA MODEL

The advancement of AI-powered surveillance is the most significant evolution in digital authoritarianism. High-resolution cameras, facial recognition, spying malware, automated text analysis, and big-data processing have opened up a wide range of new methods of citizen control. These technologies allow governments to monitor citizens and identify dissidents in a timely—and sometimes even preemptive—manner.

No regime has exploited the repressive potential of AI quite as thoroughly as the one in China. The Chinese Communist Party collects an incredible amount of data on individuals and businesses: tax returns, bank statements, purchasing histories, and criminal and medical records. The regime then uses ai to analyze this information and compile “social credit scores,” which it seeks to use to set the parameters of acceptable behavior and improve citizen control. Individuals or companies deemed “untrustworthy” can find themselves excluded from state-sponsored benefits, such as deposit-free apartment rentals, or banned from air and rail travel. Although the ccp is still honing this system, advances in big-data analysis and decision-making technologies will only improve the regime’s capacity for predictive control, what the government calls “social management.”

China also demonstrates the way digital repression aids the physical variety—on a mass scale. In Xinjiang, the Chinese government has detained more than a million Uighurs in “reeducation” camps. Those not in camps are stuck in cities where neighborhoods are surrounded by gates equipped with facial recognition software. That software determines who may pass, who may not, and who will be detained on sight. China has collected a vast amount of data on its Uighur population, including cell phone information, genetic data, and information about religious practices, which it aggregates in an attempt to stave off actions deemed harmful to public order or national security.

New technologies also afford Chinese officials greater control over members of the government. Authoritarian regimes are always vulnerable to threats from within, including coups and high-level elite defections. With the new digital tools, leaders can keep tabs on government officials, gauging the extent to which they advance regime objectives and rooting out underperforming officials who over time can tarnish public perception of the regime. For example, research has shown that Beijing avoids censoring citizens’ posts about local corruption on Weibo (the Chinese equivalent of Twitter) because those posts give the regime a window into the performance of local officials.

In addition, the Chinese government deploys technology to perfect its systems of censorship. AI, for example, can sift through massive amounts of images and text, filtering and blocking content that is unfavorable to the regime. As a protest movement heated up in Hong Kong last summer, for example, the Chinese regime simply strengthened its “Great Firewall,” removing subversive content from the Internet in mainland China almost instantaneously. And even if censorship fails and dissent escalates, digital autocracies have an added line of defense: they can block all citizens’ access to the Internet (or large parts of it) to prevent members of the opposition from communicating, organizing, or broadcasting their messages. In Iran, for example, the government successfully shut down the Internet across the country amid widespread protests last November.

Although China is the leading player in digital repression, autocracies of all stripes are looking to follow suit. The Russian government, for example, is taking steps to rein in its citizens’ relative freedom online by incorporating elements of China’s Great Firewall, allowing the Kremlin to cut off the country’s Internet from the rest of the world. Likewise, Freedom House reported in 2018 that several countries were seeking to emulate the Chinese model of extensive censorship and automated surveillance, and numerous officials from autocracies across Africa have gone to China to participate in “cyberspace management” training sessions, where they learn Chinese methods of control.

THE VELVET GLOVE

Today’s technologies not only make it easier for governments to repress critics; they also make it easy to co-opt them. Tech-powered integration between government agencies allows the Chinese regime to more precisely control access to government services, so that it can calibrate the distribution—or denial—of everything from bus passes and passports to jobs and access to education. The nascent social credit system in China has the effect of punishing individuals critical of the regime and rewarding loyalty. Citizens with good social credit scores benefit from a range of perks, including expedited overseas travel applications, discounted energy bills, and less frequent audits. In this way, new technologies help authoritarian regimes fine-tune their use of reward and refusal, blurring the line between co-option and coercive control.

Dictatorships can also use new technologies to shape public perception of the regime and its legitimacy. Automated accounts (or “bots”) on social media can amplify influence campaigns and produce a flurry of distracting or misleading posts that crowd out opponents’ messaging. This is an area in which Russia has played a leading role. The Kremlin floods the Internet with pro-regime stories, distracting online users from negative news, and creates confusion and uncertainty through the spread of alternative narratives.

Maturing technologies such as so-called microtargeting and deepfakes—digital forgeries impossible to distinguish from authentic audio, video, or images—are likely to further boost the capacity of authoritarian regimes to manipulate their citizens’ perceptions. Microtargeting will eventually allow autocracies to tailor content for specific individuals or segments of society, just as the commercial world uses demographic and behavioral characteristics to customize advertisements. Ai-powered algorithms will allow autocracies to microtarget individuals with information that either reinforces their support for the regime or seeks to counteract specific sources of discontent. Likewise, the production of deepfakes will make it easier to discredit opposition leaders and will make it increasingly difficult for the public to know what is real, sowing doubt, confusion, and apathy.

Digital tools might even help regimes make themselves appear less repressive and more responsive to their citizens. In some cases, authoritarian regimes have deployed new technologies to mimic components of democracy, such as participation and deliberation. Some local Chinese officials, for example, are using the Internet and social media to allow citizens to voice their opinions in online polls or through other digitally based participatory channels. A 2014 study by the political scientist Rory Truex suggested that such online participation enhanced public perception of the ccp among less educated citizens. Consultative sites, such as the regime’s “You Propose My Opinion” portal, make citizens feel that their voices matter without the regime having to actually pursue genuine reform. By emulating elements of democracy dictatorships can improve their attractiveness to citizens and deflate the bottom-up pressure for change.

DURABLE DIGITAL AUTOCRACIES

As autocracies have learned to co-opt new technologies, they have become a more formidable threat to democracy. In particular, today’s dictatorships have grown more durable. Between 1946 and 2000—the year digital tools began to proliferate—the typical dictatorship ruled for around ten years. Since 2000, this number has more than doubled, to nearly 25 years.

Not only has the rising tide of technology seemingly benefited all dictatorships, but our own empirical analysis shows that those authoritarian regimes that rely more heavily on digital repression are among the most durable. Between 2000 and 2017, 37 of the 91 dictatorships that had lasted more than a year collapsed; those regimes that avoided collapse had significantly higher levels of digital repression, on average, than those that fell. Rather than succumb to what appeared to be a devastating challenge to their power—the emergence and spread of new technologies—many dictatorships leverage those tools in ways that bolster their rule.

Although autocracies have long relied on various degrees of repression to support their objectives, the ease with which today’s authoritarian regimes can acquire this repressive capacity marks a significant departure from the police states of the past. Building the effectiveness and pervasiveness of the East German Stasi, for example, was not something that could be achieved overnight. The regime had to cultivate the loyalty of thousands of cadres, training them and preparing them to engage in on-the-ground surveillance. Most dictatorships simply do not have the ability to create such a vast operation. There was, according to some accounts, one East German spy for every 66 citizens. The proportion in most contemporary dictatorships (for which there are data) pales in comparison. It is true that in North Korea, which ranks as possibly the most intense police state in power today, the ratio of internal security personnel and informants to citizens is 1 to 40—but it was 1 to 5,090 in Iraq under Saddam Hussein and 1 to 10,000 in Chad under Hissene Habre. In the digital age, however, dictatorships don’t need to summon immense manpower to effectively surveil and monitor their citizens.

Instead, aspiring dictatorships can purchase new technologies, train a small group of officials in how to use them—often with the support of external actors, such as China—and they are ready to go. For example, Huawei, a Chinese state-backed telecommunications firm, has deployed its digital surveillance technology in over a dozen authoritarian regimes. In 2019, reports surfaced that the Ugandan government was using it to hack the social media accounts and electronic communications of its political opponents. The vendors of such technologies don’t always reside in authoritarian countries. Israeli and Italian firms have also sold digital surveillance software to the Ugandan regime. Israeli companies have sold espionage and intelligence-gathering software to a number of authoritarian regimes across the world, including Angola, Bahrain, Kazakhstan, Mozambique, and Nicaragua. And U.S. firms have exported facial recognition technology to governments in Saudi Arabia and the United Arab Emirates.

A SLIPPERY SLOPE

As autocracies last longer, the number of such regimes in place at any point in time is likely to increase, as some countries backslide on democratic rule. Although the number of autocracies globally has not risen substantially in recent years, and more people than ever before live in countries that hold free and fair elections, the tide may be turning. Data collected by Freedom House show, for example, that between 2013 and 2018, although there were three countries that transitioned from “partly free” to “free” status (the Solomon Islands, Timor-Leste, and Tunisia), there were seven that experienced the reverse, moving from a status of “free” to one of “partly free” (the Dominican Republic, Hungary, Indonesia, Lesotho, Montenegro, Serbia, and Sierra Leone).

The risk that technology will usher in a wave of authoritarianism is all the more concerning because our own empirical research has indicated that beyond buttressing autocracies, digital tools are associated with an increased risk of democratic backsliding in fragile democracies. New technologies are particularly dangerous for weak democracies because many of these digital tools are dual use: technology can enhance government efficiency and provide the capacity to address challenges such as crime and terrorism, but no matter the intentions with which governments initially acquire such technology, they can also use these tools to muzzle and restrict the activities of their opponents.

Pushing back against the spread of digital authoritarianism will require addressing the detrimental effects of new technologies on governance in autocracies and democracies alike. As a first step, the United States should modernize and expand legislation to help ensure that U.S. entities are not enabling human rights abuses. A December 2019 report by the Center for a New American Security (where one of us is a senior fellow) highlights the need for Congress to restrict the export of hardware that incorporates AI-enabled biometric identification technologies, such as facial, voice, and gait recognition; impose further sanctions on businesses and entities that provide surveillance technology, training, or equipment to authoritarian regimes implicated in human rights abuses; and consider legislation to prevent U.S. entities from investing in companies that are building ai tools for repression, such as the Chinese ai company SenseTime.

The U.S. government should also use the Global Magnitsky Act, which allows the U.S. Treasury Department to sanction foreign individuals involved in human rights abuses, to punish foreigners who engage in or facilitate Ai-powered human rights abuses. Ccp officials responsible for atrocities in Xinjiang are clear candidates for such sanctions.

U.S. government agencies and civil society groups should also pursue actions to mitigate the potentially negative effects of the spread of surveillance technology, especially in fragile democracies. The focus of such engagement should be on strengthening the political and legal frameworks that govern how surveillance technologies are used and building the capacity of civil society and watchdog organizations to check government abuse.

What is perhaps most critical, the United States must make sure it leads in AI and helps shape global norms for its use in ways that are consistent with democratic values and respect for human rights. This means first and foremost that Americans must get this right at home, creating a model that people worldwide will want to emulate. The United States should also work in conjunction with like-minded democracies to develop a standard for digital surveillance that strikes the right balance between security and respect for privacy and human rights. The United States will also need to work closely with like-minded allies and partners to set and enforce the rules of the road, including by restoring U.S. leadership in multilateral institutions such as the United Nations.

AI and other technological innovations hold great promise for improving everyday lives, but they have indisputably strengthened the grip of authoritarian regimes. The intensifying digital repression in countries such as China offers a bleak vision of ever-expanding state control and ever-shrinking individual liberty.

But that need not be the only vision. In the near term, rapid technological change will likely produce a cat-and-mouse dynamic as citizens and governments race to gain the upper hand. If history is any guide, the creativity and responsiveness of open societies will in the long term allow democracies to more effectively navigate this era of technological transformation. Just as today’s autocracies have evolved to embrace new tools, so, too, must democracies develop new ideas, new approaches, and the leadership to ensure that the promise of technology in the twenty-first century doesn’t become a curse.

#### Democratic backsliding causes nuclear war

Dr. Larry Diamond 19. Professor of Political Science and Sociology at Stanford University, Senior Fellow at the Hoover Institution, Senior Fellow at the Freeman Spogli Institute for International Studies, PhD in Sociology from Stanford University, Ill Winds: Saving Democracy from Russian Rage, Chinese Ambition, and American Complacency, p. 199-202

The most obvious response to the ill winds blowing from the world’s autocracies is to help the winds of freedom blowing in the other direction. The democracies of the West cannot save themselves if they do not stand with democrats around the world.

This is truer now than ever, for several reasons. We live in a globalized world, one in which models, trends, and ideas cascade across borders. Any wind of change may gather quickly and blow with gale force. People everywhere form ideas about how to govern—or simply about which forms of government and sources of power may be irresistible—based on what they see happening elsewhere. We are now immersed in a fierce global contest of ideas, information, and norms. In the digital age, that contest is moving at lightning speed, shaping how people think about their political systems and the way the world runs. As doubts about and threats to democracy are mounting in the West, this is not a contest that the democracies can afford to lose.

Globalization, with its flows of trade and information, raises the stakes for us in another way. Authoritarian and badly governed regimes increasingly pose a direct threat to popular sovereignty and the rule of law in our own democracies. Covert flows of money and influence are subverting and corrupting our democratic processes and institutions. They will not stop just because Americans and others pretend that we have no stake in the future of freedom in the world. If we want to defend the core principles of self-government, transparency, and accountability in our own democracies, we have no choice but to promote them globally.

It is not enough to say that dictatorship is bad and that democracy, however flawed, is still better. Popular enthusiasm for a lesser evil cannot be sustained indefinitely. People need the inspiration of a positive vision. Democracy must demonstrate that it is a just and fair political system that advances humane values and the common good.

To make our republics more perfect, established democracies must not only adopt reforms to more fully include and empower their own citizens. They must also support people, groups, and institutions struggling to achieve democratic values elsewhere. The best way to counter Russian rage and Chinese ambition is to show that Moscow and Beijing are on the wrong side of history; that people everywhere yearn to be free; and that they can make freedom work to achieve a more just, sustainable, and prosperous society.

In our networked age, both idealism and the harder imperatives of global power and security argue for more democracy, not less. For one thing, if we do not worry about the quality of governance in lower-income countries, we will face more and more troubled and failing states. Famine and genocide are the curse of authoritarian states, not democratic ones. Outright state collapse is the ultimate, bitter fruit of tyranny. When countries like Syria, Libya, and Afghanistan descend into civil war; when poor states in Africa cannot generate jobs and improve their citizens’ lives due to rule by corrupt and callous strongmen; when Central American societies are held hostage by brutal gangs and kleptocratic rulers, people flee—and wash up on the shores of the democracies. Europe and the United States cannot withstand the rising pressures of immigration unless they work to support better, more stable and accountable government in troubled countries. The world has simply grown too small, too flat, and too fast to wall off rotten states and pretend they are on some other planet.

Hard security interests are at stake. As even the Trump administration’s 2017 National Security Strategy makes clear, the main threats to U.S. national security all stem from authoritarianism, whether in the form of tyrannies from Russia and China to Iran and North Korea or in the guise of antidemocratic terrorist movements such as ISIS.1 By supporting the development of democracy around the world, we can deny these authoritarian adversaries the geopolitical running room they seek. Just as Russia, China, and Iran are trying to undermine democracies to bend other countries to their will, so too can we contain these autocrats’ ambitions by helping other countries build effective, resilient democracies that can withstand the dictators’ malevolence.

Of course, democratically elected governments with open societies will not support the American line on every issue. But no free society wants to mortgage its future to another country. The American national interest would best be secured by a pluralistic world of free countries—one in which autocrats can no longer use corruption and coercion to gobble up resources, alliances, and territory.

If you look back over our history to see who has posed a threat to the United States and our allies, it has always been authoritarian regimes and empires. As political scientists have long noted, no two democracies have ever gone to war with each other—ever. It is not the democracies of the world that are supporting international terrorism, proliferating weapons of mass destruction, or threatening the territory of their neighbors.

For all these reasons, we need a new global campaign for freedom. Everything I am proposing in this book plays a role in that campaign, but in this chapter, I am concerned more narrowly with the ways that we can directly advance democracy, human rights, and the rule of law in the twenty-first-century world.

As with any policy area, many of the challenges can be somewhat technical, requiring smart design and the careful management of programs and institutions. Those operational debates I leave for another venue. Here, I make a more basic case for four imperatives. First, we must support the democrats of the world—the people and organizations struggling to create and improve free and accountable government. Second, we must support struggling and developing democracies, helping them to grow their economies and strengthen their institutions. Third, we must pressure authoritarian regimes to stop abusing the rights and stealing the resources of their citizens, including by imposing sanctions on dictators to make them think hard about their choices and separate them from both their supporters and the people at large. Finally, we need to reboot our public diplomacy—our global networks of information and ideas—for today’s fast-paced age of information and disinformation. For the sake of both our interests and our values, we need a foreign policy that puts a high priority on democracy, human rights, and the rule of law.

### 1NC - OFF

Competitiveness DA

#### Semiconductor legislation passes now---key to counter China---but it’s not done yet. Biden’s push is key.

Oregon Live 4-18. . "Congress works to cut deal on $52B for semiconductor industry". oregonlive. 4-18-2022. https://www.oregonlive.com/silicon-forest/2022/04/congress-works-to-cut-deal-on-52-billion-in-funding-for-semiconductor-industry.html

A global computer chip shortage has made it harder for consumers to get their hands on cars, computers and other modern-day necessities, so Congress is looking to boost chip manufacturing and research in the United States with billions of dollars from the federal government. Both the House and the Senate have passed major legislation on the matter, and the effort is one of lawmakers’ final opportunities before the November elections to show voters they are addressing the nation’s strained supply chains. Both bills contain $52 billion in so-called “CHIPS Act” funding to subsidize domestic semiconductor manufacturing and research, money supporters say could help make the U.S. more competitive with Asian nations and stay ahead of China’s emerging chip industry. Intel, Oregon’s largest corporate employer, is counting on a share of that money to help offset some of the $40 billion it plans to spend to build new factories in Arizona and Ohio. CEO Pat Gelsinger, speaking in Oregon last week, said he was “praying” Congress would pass a bill by Memorial Day. For that to happen, Congress will have to work out considerable differences between the House and Senate versions. And Republicans are already digging in before the negotiations formally begin. President Joe Biden has made the semiconductor legislation a top priority, but he’ll need the support of 10 Senate Republicans, and perhaps more, to get a bill to his desk. Senate Republican leader Mitch McConnell emphasized that point when congressional leaders recently announced which lawmakers will serve on the committee that works to reconcile the two bills. “Without major concessions and changes from House Democrats, this legislation has no chance of becoming law,” McConnell said. House Democrats say their voices need to be heard during negotiations. “We need to make sure that everyone has input,” said Rep. Suzan DelBene, D-Wash., chair of the New Democratic Coalition, a group that has 19 members participating in negotiations. “We have a strong bill in the House, and I think there’s important components there that the Senate should also consider.” The Senate bill is projected to increase spending by about $250 billion over 10 years. The House bill would boost spending by more than $400 billion over the period. Four Oregon Democrats serve on the conference committee seeking to hash out differences: Sen. Ron Wyden and House members Earl Blumenauer, Peter DeFazio and Suzanne Bonamici. “We’re going to push as hard as we can to move as fast as we can,” Wyden said in an interview with The Oregonian/OregonLive last week. He wouldn’t commit to a target date for passing a bill but said Congress is united in its desire to see the U.S. maintain a technological advantage over China. “I think that strengthens our hand in terms of getting this done quickly,” he said. Al Thompson, Intel’s vice president for government relations, said Friday he’s confident that Congress will pass a bill — but maybe not by Gelsinger’s Memorial Day target. “I think it happens. You rarely name conferees on a bill you don’t plan to pass,” Thompson told The Oregonian/OregonLive. He said Russia’s invasion of Ukraine reawakened Congress to the risks geopolitical turmoil create for global supply gains. “That’s helped drive some focus,” Thompson said. “I’m confident they’re going to get a bill done.” WHERE THERE IS MUCH AGREEMENT The Senate and House bills allot more than $52 billion for semiconductor production and research. Grants and loans from the federal government would subsidize some of the cost of building or renovating semiconductor plants. “The chips funding is absolutely the foundation of this bill — it’s a bipartisan foundation,” said Josh Teitelbaum, senior counsel at Akin Gump, a law and lobbying firm. “I think it is what is driving this toward the finish line.” SOME OVERLAP, BUT KEY DIFFERENCES Both bills authorize a big boost in spending for the National Science Foundation, but they have different priorities for the research receiving funding. The Senate bill provides $29 billion over five years to a new directorate focused on strengthening U.S. leadership in artificial intelligence, semiconductors, robotics and other cutting-edge technologies. The House bill provides $13.3 billion over five years to a new directorate for science and engineering solutions. It lists climate change, environmental sustainability and social and economic inequality as part of the directorate’s focus. The two sides will have to hammer out their competing visions for the National Science Foundation and the new tech directorate. The two bills also establish regional technology hubs — with the Senate dedicating $10 billion to the program and the House dedicating $7 billion. The Senate bill calls for 20 such hubs, while the House bill authorizes at least 10. The seed money would go to regional organizations seeking to advance a variety of economic and national security priorities. The approach has bipartisan support from lawmakers with big rural and minority constituencies who want to ensure the money is not concentrated in universities or communities where a lot of tech research is already done. Oregon political leaders say they want to ensure that a share of that money comes to the Portland area, which has one of the densest concentrations of semiconductor manufacturing and research of any state. It’s not clear, though, whether any money that came to Oregon would go to universities, an industry consortium or directly fund Intel’s Hillsboro activities. Intel’s does its most advanced research at its Oregon campuses, so Thompson said a big share of any research money the company receives likely will be spent there. “I think it’s a pretty good chance that Intel will have a significant component of it in Oregon,” he said. WHERE THERE ARE MAJOR DIFFERENCES The bills diverge on supply chain issues, trade, immigration and climate change, to name a few areas of disagreement. One of the big-ticket items is a $45 billion program in the House bill to enhance supply chains in the U.S. There was no such provision in the Senate bill. The money would provide grants, loans or loan guarantees to companies, local governments and tribes trying to build or relocate manufacturing plants producing critical goods. “This is a real area of focus for companies and for communities who want to try to bring back manufacturing,” Teitelbaum said. “There’s a lot of interest in including this funding in the final package.” Another stark difference is on trade. The House reauthorizes a program that provides training and financial assistance for those who lose their jobs or have their hours cut because of increased imports. The Senate has no such provision. “It’s not going to move without trade adjustment assistance,” Rep. Earl Blumenauer, D-Ore., said of the bill. Meanwhile, the Senate bill includes a trade provision that would exclude more products from tariffs the Trump administration put in place on goods imported from China. Those exclusions have almost all expired. The Senate bill reinstates them, a priority of business groups such as the U.S. Chamber of Commerce. The House bill addresses immigration, while the Senate bill does not. It would create a new visa category for entrepreneurs and would allow those with an ownership interest in successful ventures to apply to become lawful permanent residents. The House bill, unlike the Senate bill, also touches on climate change. It dedicates $8 billion to a fund that helps developing countries adjust to climate change. That could be a nonstarter for Republicans, who object to using U.S. taxpayer money for that purpose. No one expects the negotiations to be easy. “I have a hard time explaining to my friends and constituents,” said Sen. John Cornyn, R-Texas, “that when the White House is in favor of something, when Democrats are in favor of something, Republicans are in favor of something, the House is in favor of it, and the Senate is in favor of it, we still can’t seem to get it done. But I hope that we will take advantage of this opportunity.”

#### Plan drains PC and trades off.

Peter C. Carstensen 21. Fred W. & Vi Miller Chair in Law Emeritus, University of Wisconsin Law School, February 2021. “The “Ought” And “Is Likely” Of Biden Antitrust,” https://www.concurrences.com/en/review/issues/no-1-2021/on-topic/the-new-us-antitrust-administration-en

14. Similarly, despite bipartisan murmurs about competitive issues, the potential in a closely divided Congress that any major initiatives will survive is limited at best. In part the challenge here is how the Biden administration will rank its commitments. If it were to make reform of competition law a major and primary commitment, it would have to trade off other goals, which might include health care reform or increases in the minimum wage. It is likely in this circumstance the new administration, like the Obama administration’s abandonment of the pro-competitive rules proposed under the PSA, would elect to give up stricter competition rules in order to achieve other legislative priorities. 15. Another key to a robust commitment to workable competition is the choice of cabinet and other key administrative positions. Here as well, the early signs are not entirely encouraging. In selecting Tom Vilsack to return as secretary of agriculture, the president has embraced a friend of the large corporate interests dominating agriculture who has spent the last four years in a highly lucrative position advancing their interests. Given the desperate need for pro-competitive rules to implement the PSA and control exploitation of dairy farmers through milk-market orders, the return of Vilsack is not good news. Who will head the FTC and who will be the attorney general and assistant attorney general for antitrust is still unknown, but if those picks are also centrists with strong links to corporate America the hope for robust enforcement of competition law will further attenuate! 16. In sum, this is a pessimistic prognostication for the likely Biden antitrust enforcement agenda. There is much that ought to be done. But this requires a willingness to take major enforcement risks, to invest significant political capital in the legislative process, and to select leaders who are committed to advancing the public interest in fair, efficient and dynamically competitive markets. The early signs are that the new administration will be no more committed to robust competition policy than the Obama administration. Events may force a more vigorous policy—I will cling to that hope as the Biden administration takes shape.

#### Chinese tech edge causes extinction from nuclear war and emerging tech.

Ash Jain 19. Senior fellow with the Scowcroft Center for Strategy and Security, where he oversees the Atlantic Council’s Democratic Order Initiative and D10 Strategy Forum; and Matthew Kroenig, deputy director for strategy in the Scowcroft Center for Strategy and Security and associate professor of government and foreign service at Georgetown University, 10/30/19, “Present at the Re-Creation: A Global Strategy for Revitalizing, Adapting, and Defending a Rules-Based International System,” <https://www.atlanticcouncil.org/wp-content/uploads/2019/10/Present-at-the-Recreation.pdf>

The system must also be adapted to deal with new issues that were not envisioned when the existing order was designed. Foremost among these issues is emerging and disruptive technology, including AI, additive manufacturing (or 3D printing), quantum computing, genetic engineering, robotics, directed energy, the Internet of things (IOT), 5G, space, cyber, and many others. Like other disruptive technologies before them, these innovations promise great benefits, but also carry serious downside risks. For example, AI is already resulting in massive efficiencies and cost savings in the private sector. Routine tasks and other more complicated jobs, such as radiology, are already being automated. In the future, autonomous weapons systems may go to war against each other as human soldiers remain out of harm’s way. Yet, AI is also transforming economies and societies, and generating new security challenges. Automation will lead to widespread unemployment. The final realization of driverless cars, for example, will put out of work millions of taxi, Uber, and long-haul truck drivers. Populist movements in the West have been driven by those disaffected by globalization and technology, and mass unemployment caused by automation will further grow those ranks and provide new fuel to grievance politics. Moreover, some fear that autonomous weapons systems will become “killer robots” that select and engage targets without human input, and could eventually turn on their creators, resulting in human extinction. The other technologies on this lisgt similarly balance great potential upside with great downside risk. 3D printing, for example, can be used to “make anything anywhere,” reducing costs for a wide range of manufactured goods and encouraging a return of local manufacturing industries.61 At the same time, advanced 3D printers can also be used by revisionist and rogue states to print component parts for advanced weapons systems or even WMD programs, spurring arms races and weapons proliferation.62 Genetic engineering can wipe out entire classes of disease through improved medicine, or wipe out entire classes of people through genetically engineered superbugs. Directed-energy missile defenses may defend against incoming missile attacks, while also undermining global strategic stability. Perhaps the greatest risk to global strategic stability from new technology, however, comes from the risk that revisionist autocracies may win the new tech arms race. Throughout history, states that have dominated the commanding heights of technological progress have also dominated international relations. The United States has been the world’s innovation leader from Edison’s light bulb to nuclear weapons and the Internet. Accordingly, stability has been maintained in Europe and Asia for decades because the United States and its democratic allies possessed a favorable economic and military balance of power in those key regions. Many believe, however, that China may now have the lead in the new technologies of the twenty-first century, including AI, quantum, 5G, hypersonic missiles, and others. If China succeeds in mastering the technologies of the future before the democratic core, then this could lead to a drastic and rapid shift in the balance of power, upsetting global strategic stability, and the call for a democratic- led, rules-based system outlined in these pages.63

## CASE

### 1NC - AT: Innovation

#### No impact to innovation --- Matthews evidence is vague techno-utopianism --- at least, winning an ext impact now doesn’t mean tech can solve

#### NASA thumps --- research incentives create innovation --- Haven reads green.

Joshua Hampson 2017, Security Studies Fellow at the Niskanen Center, 1-25-2017, “The Future of Space Commercialization”, Niskanen Center, https://republicans-science.house.gov/sites/republicans.science.house.gov/files/documents/TheFutureofSpaceCommercializationFinal.pdf

Innovation is generally hard to predict; some new technologies seem to come out of nowhere and others only take off when paired with a new application. It is difficult to predict the future, but it is reasonable to expect that a growing space economy would open opportunities for technological and organizational innovation. In terms of technology, the difficult environment of outer space helps incentivize progress along the margins. Because each object launched into orbit costs a significant amount of money—at the moment between $27,000 and $43,000 per pound, though that will likely drop in the future —each 19 reduction in payload size saves money or means more can be launched. At the same time, the ability to fit more capability into a smaller satellite opens outer space to actors that previously were priced out of the market. This is one of the reasons why small, affordable satellites are increasingly pursued by companies or organizations that cannot afford to launch larger traditional satellites. These small 20 satellites also provide non-traditional launchers, such as engineering students or prototypers, the opportunity to learn about satellite production and test new technologies before working on a full-sized satellite. That expansion of developers, experimenters, and testers cannot but help increase innovation opportunities. Technological developments from outer space have been applied to terrestrial life since the earliest days of space exploration. The National Aeronautics and Space Administration (NASA) maintains a website that lists technologies that have spun off from such research projects. Lightweight 21 nanotubes, useful in protecting astronauts during space exploration, are now being tested for applications in emergency response gear and electrical insulation. The need for certainty about the resiliency of materials used in space led to the development of an analytics tool useful across a range of industries. Temper foam, the material used in memory-foam pillows, was developed for NASA for seat covers. As more companies pursue their own space goals, more innovations will likely come from the commercial sector. Outer space is not just a catalyst for technological development. Satellite constellations and their unique line-of-sight vantage point can provide new perspectives to old industries. Deploying satellites into low-Earth orbit, as Facebook wants to do, can connect large, previously-unreached swathes of 22 humanity to the Internet. Remote sensing technology could change how whole industries operate, such as crop monitoring, herd management, crisis response, and land evaluation, among others. 23 While satellites cannot provide all essential information for some of these industries, they can fill in some useful gaps and work as part of a wider system of tools. Space infrastructure, in helping to change how people connect and perceive Earth, could help spark innovations on the ground as well. These innovations, changes to global networks, and new opportunities could lead to wider economic growth.

#### Only warrant is setting prices for innovation. Capitalism stifles them. Propriety rights, no incentive for R&D.

Vanessa A .Bee 18 Senior Litigation Counsel at the Consumer Financial Protection Bureau with a JD from Harvard Law. Innovation Under Socialism. 10-24-2018. <https://www.currentaffairs.org/2018/10/innovation-under-socialism>

But prioritizing profit is a double-edged sword that can hamper innovation. Owning the proprietary rights allows private firms to block workers—through anti-competitive tools like non-compete agreements, patents, and licenses—who put labor into the innovation process from applying the extensive technical expertise and intimate understanding of the product to improve the innovation substantially. This becomes especially relevant once the workers leave the firm division in which they worked, or leave the firm altogether. Understandably, this lack of control and ownership will cause some workers, however passionate they may be about a project, to be less willing to maximize their contribution to the innovation.

Of course, the so-called nimbleness that allows firms to make drastic changes like mass layoffs is extremely harmful to the workers. This is no fluke. The capitalist economy thrives on a reserve army of labor. Inching closer to full employment makes workers scarcer, which empowers the labor force as a whole to bargain for higher wages and better work conditions. These threaten the firm’s bottom line. So, the capitalist economy is structured to maintain the balance of power towards the owners of capital. Positions that pay well (and less than well) come with the precariousness of at-will employment and disappearing union power. A constant pool of unemployed labor is maintained through layoffs and other tactics like higher interest rates, which the government will compel to help slow growth and thereby hiring. This system harms the potential for innovation, too.

The fear of losing work can dissuade workers from taking risks, experimenting, or speaking up as they identify items that could improve a taken approach—all actions that foster innovation. Meanwhile, thousands of individuals who could be contributing to the innovative process are instead involuntarily un-employed. This model also encourages monopolization, as concentrating market power gives private firms the most control over how much profit they can extract. But squashing competition that could contribute fresh ideas hurts every phase of the innovation process, while giving workers in fewer workplaces space to innovate.

Deferring to profit causes many areas of R&D to go unexplored. Private firms have less reason to invest in innovations likely to be made universally available for free if managers or investors do not see much upside for the firm’s bottom line. In theory, the slack in private research can be picked up by the public sector. In reality, however, decades of austerity measures  threaten the public’s ability to underwrite risky and inefficient research. Both the Democratic and Republican parties increasingly adhere to a neoliberal ideology that vilifies “big government,” promotes running government like a business, pretends that government budgets should mirror household budgets or the private firm’s balance sheet, and rams privatization under the guises of so-called public-private partnerships and private subcontractors.

In the United States, public investment in R&D has been trending downward. As documented in a 2014 report from the Information Technology & Innovation Foundation, “[f]rom 2010 to 2013, federal R&D spending fell from $158.8 to $133.2 billion … Between 2003 and 2008, state funding for university research, as a share of GDP, dropped on average by 2 percent. States such as Arizona and Utah saw decreases of 49 percent and 24 percent respectively.” Even if public investment in the least profitable aspect of research suddenly surged, in our current model, the private sector continues to be the primary driver of development, production, and distribution. Where there remains little potential for profit, private firms will be reluctant to advance to the next phases of the innovation process. Public-private projects raise similar concerns. Coordinated efforts can increase private investment by spreading some costs and risk to the public. But to attract private partners in the first place, the public sector has a greater incentive to prioritize R&D projects with more financial upsides.

This is how the quest for profits and tight grip over proprietary rights, both important features of the capitalist model, discourage risk. Innovations are bound for plateauing after a few years, as firms increasingly favor minor aesthetic tweaks and updates over bold ideas while preventing other avenues of innovation from blossoming. At the same time, massive amounts of capital continue to float into the hands of a few. The price of innovating under capitalism is then both decreased innovation and decreased equality. The idea that this approach to innovation must be our best and only option is a delusion.

### 1NC - AT: Rocket Launches

#### Massive public sector alt cause

### 1NC - AT: Debris

#### No one’s going to war over a downed satellite

Bowen 18 [Bleddyn Bowen, Lecturer in International Relations at the University of Leicester. The Art of Space Deterrence. February 20, 2018. https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/]

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.

#### Orwig is a science journalist --- not qualified to make predicitons about state relations

#### Blatt is a student and studies biology --- significantly less weight

#### Only damaging debris generates political pressure

Schladebach, 13—visiting professor at the University of Göttingen in Air Law (Marcus, “Space Debris as a Legal Challenge,” Max Planck Yearbook of United Nations Law Online, Volume 17, Issue 1, 61-85, dml)

A number of stakeholders claim that the removal of inactive satellites or other Space debris would be too expensive.47 According to satellite producers, the production, transport to an orbit in Outer Space and use of a satellite are so cost-intensive that further investments cannot feasibly be borne without severely restricting them. Another reason for the lack of regulation concerning Space debris lies in the fact that political pressure surrounding the problem is still quite weak.48

In many cases, mankind only becomes active when greater damage has occurred. Despite the older and younger incidents mentioned above, damage on a catastrophic level, to such an extent that one could speak of an overwhelming and immediate necessity to regulate, is yet to happen. Although there would be a real chance to avoid damages with foresighted regulation, the law will unfortunately remain in a reactive role. Whether these aspects justify the inactivity of the state community seems doubtful. States are entitled to give their opinion whether they are ready for further investments and to evaluate the question of how intensive the danger of damage is. However, it should be obvious for the state community that the territorial integrity and individual security of states face considerable damage if the state community continues to remain inactive.

#### Low-level debris collisions now are key to infrastructure resilience—otherwise critical systems are decked by 2050

Mureșan and Georgescu, 15—currently leads the EURISC Foundation, served as senior adviser to the Romanian prime minister, the government and the minister of interior AND Research Fellow with the EURISC Foundation (Liviu and Alexandru, “The Road to Resilience in 2050,” The RUSI Journal, Volume 160, 2015 - Issue 6, dml)

By extrapolating these trends to 2050, mindful of potential technological breakthroughs, it is possible to paint a picture of how space systems will both add to and detract from the goal of ensuring societal resilience. By that point, every country developed to at least the economic and technological level of the developed world in the early twentyfirst century will have become critically dependent on space systems, especially for emerging countries which have leapfrogged over technological stages to directly use space services. Countries will be richer and safer from a host of potential disasters and disruptions through ubiquitous surveillance, information gathering and co-ordination at an accessible price through space systems.

However, the benefits of space systems can only accrue through a rate of adoption that engenders a critical dependence. By 2050, the world will be at the height of its vulnerability to space debris and space-weather phenomena. When it comes to deliberate threats, there will be a cautious détente between spacefaring nations maintained by crosscutting issues of dependence, if not on the same systems, then at least on the health and safety of the ‘global commons in space’. Due to the development and propagation of cost-effective technologies with anti-satellite applicability masked by legitimate uses, this will also be a time of opportunity for non-state actors looking to disrupt world affairs to target space systems and commit a ‘victimless’ crime. It is arguable that space systems will themselves have become more resilient – even to deliberate threats, especially of the kind accessible to non-state actors (cybernetics, jamming and so forth) – but security actors must also take into account the financial and market impact of temporary disruptions, based on the psychological effects of prevailing uncertainty, which are beyond the security decision-makers’ ability to affect.

The main barrier to a world that is more resilient in many more respects than today is the task of creating a global governance framework underpinned by real powers to regulate space activity in a way that increases resilience. The current framework, based on voluntary associations between space agencies and other actors, as well as the voluntary adoption of technical standards without power and authority to penalise actors who deviate from these norms, is woefully inadequate. The UN’s Committee on the Peaceful Uses of Outer Space has been developing such technical standards, but with little power of enforcement.33 Different treaties are supported by a mosaic of states, which are at various stages of adopting them, while other treaties lack the support of the most powerful space players, who are holding out for a framework that is to their specific advantage34 (as happened, for instance, with the failed Space Asset Protocol proposed by Unidroit, a private institution dedicated to harmonising commercial law35). Organisations such as the International Telecommunication Union, which regulates and assigns communication frequency bands to avoid ‘frequency fratricide’ between nearby satellites (which can also potentially be used as an ASAT weapon), show that the ‘orbital commons’ can be adequately regulated.36

Looking to the future, a global governance framework conducive to such resilience should: regulate the production and disposal of new space debris; regulate oversaturated orbital bands, preferably through market mechanisms; incentivise the development and application of methods for clearing up orbital debris; promote the adoption of resilient satellite design, taking advantage of new technologies and lower costs of launch (for shielding) to increase lifespan and decrease failures, as well as ensure the greatest possible interoperability; develop a multi-stakeholder model of governance, focused especially on co-opting private actors (who will own the bulk of future satellites) in a securityconscious process while addressing their needs for an environment more conducive to commercial exploitation. Such discussions should also incorporate non-spacefaring states, which must nevertheless take space security into account when devising critical infrastructure protection strategies and activities. This is especially important since, in an interconnected world, one weak link also undermines other countries through cascading disruption, even though they might have considered themselves to be adequately protected from threats. A key part of this will be a comprehensive effort at disseminating knowledge, best practices, and critical technologies and standards, while co-opting as many members as possible into arrangements such as early-warning networks and rapid-intervention initiatives. Last, but certainly not least, a focus on terrestrial infrastructure will also be essential, particularly in hardening it against threats such as space-weather phenomena – this involves not only investments and upgrades on the ground, but the use of space systems for the provision of early warning and further research into the patterns, causes and even warning signs of such phenomena.

In the end, space systems are a critical tool in negotiating the often conflicted relationship between economic development and security concerns. Their use helps to achieve a greater measure of resilience against certain kinds of disasters (such as weather patterns more extreme than ever before), but at the cost of exposure to new threats. By 2050, they will not only be integrated into existing and future critical-infrastructure protection frameworks at national, European and global levels, but they will have also gone through a number of challenges that will have strengthened resilience. Experts studying the various cases of low-intensity space-weather phenomena that have, nonetheless, caused damage have remarked on their utility as stress tests of existing infrastructure, highlighting the need to address the exposed weaknesses. As a result, the various examples of space system disruption and destruction so far have been a positive incentive for security-conscious development. This relates to the concept of ‘anti-fragility’, 37 where repeated low-level crises actually strengthen a system against a major threat which could have otherwise destroyed the system entirely. The philosophy is now being applied to critical-infrastructure protection and to space-security issues.

By 2050, the effects of past incidents will have already spawned a more resilient society, but it will have become obvious that the road to resilience extends much further into the future, as long as societies continue to develop and avoid stagnation. Resilience, in this respect, is not a destination for security experts and decision-makers, but rather a continual journey.

#### Resilience is a non-linear, infinite systemic risk – encompasses and outweighs case

Pamlin & Armstrong 15 (Dennis Pamlin, Executive Project Manager Global Risks, Global Challenges Foundation, and Stuart Armstrong, James Martin Research Fellow, Future of Humanity Institute, Oxford Martin School, University of Oxford, “Global Challenges: 12 Risks that threaten human civilization: The case for a new risk category,” Global Challenges Foundation, February 2015, p.30-93, https://api.globalchallenges.org/static/wp-content/uploads/12-Risks-with-infinite-impact.pdf)

2. Risks with infinite impact: A new category of risks “Most risk management is really just advanced contingency planning and disciplining yourself to realise that, given enough time, very low probability events not only can happen, but they absolutely will happen.” Lloyd Blankfein, Goldman Sachs CEO, July 2013 1 Risk = Probability × Impact Impacts where civilisation collapses to a state of great suffering and do not recover, or a situation where all human life end, are defined as infinite as the result is irreversible and lasts forever. A new group of global risks This is a report about a limited number of global risks – that can be identified through a scientific and transparent process – with impacts of a magnitude that pose a threat to human civilisation, or even possibly to all human life. With such a focus it may surprise some readers to find that the report’s essential aim is to inspire action and dialogue as well as an increased use of the methodologies used for risk assessment. The real focus is not on the almost unimaginable impacts of the risks the report outlines. Its fundamental purpose is to encourage global collaboration and to use this new category of risk as a driver for innovation. The idea that we face a number of global challenges threatening the very basis of our civilisation at the beginning of the 21st century is well accepted in the scientific community, and is studied at a number of leading universities.2 But there is still no coordinated approach to address this group of challenges and turn them into opportunities for a new generation of global cooperation and the creation of a global governance system capable of addressing the greatest challenges of our time. This report has, to the best of our knowledge, created the first science-based list of global risks with a potentially infinite impact and has made the first attempt to provide an initial overview of the uncertainties related to these risks as well as rough quantifications for the probabilities of these impacts. What is risk? Risk is the potential of losing something of value, weighed against the potential to gain something of value. Every day we make different kinds of risk assessments, in more or less rational ways, when we weigh different options against each other. The basic idea of risk is that an uncertainty exists regarding the outcome and that we must find a way to take the best possible decision based on our understanding of this uncertainty.3 To calculate risk the probability of an outcome is often multiplied by the impact. The impact is in most cases measured in economic terms, but it can also be measured in anything we want to avoid, such as suffering. At the heart of a risk assessment is a probability distribution, often described by a probability density function4; see figure X for a graphic illustration. The slightly tilted bell curve is a common probability distribution, but the shape differs and in reality is seldom as smooth as the example. The total area under the curve always represents 100 percent, i.e. all the possible outcomes fit under the curve. In this case (A) represents the most probable impact. With a much lower probability it will be a close to zero impact, illustrated by (B). In the same way as in case B there is also a low probability that the situation will be very significant, illustrated by (C). Figure 1: Probability density function [FIGURE 1 OMITTED] The impacts (A), (B) and (C) all belong to the same category, ~~normal~~ [common] impacts: the impacts may be more or less serious, but they can be dealt with within the current system. The impacts in this report are however of a special kind. These are impacts where everything will be lost and the situation will not be reversible, i.e challenges with potentially infinite impact. In insurance and finance this kind of risk is called “risk of ruin”, an impact where all capital is lost.5 This impact is however only infinite for the company that is losing the money. From society’s perspective, that is not a special category of risk. In this report the focus is on the “risk of ruin” on a global scale and on a human level, in the worst case this is when we risk the extinction of our own species. On a probability curve the impacts in this report are usually at the very far right with a relatively low probability compared with other impacts, illustrated by (D) in Figure 2. Often they are so far out on the tail of the curve that they are not even included in studies. For each risk in this report the probability of an infinite impact is very low compared to the most likely outcome. Some studies even indicate that not all risks in this report can result in an infinite impact. But a significant number of peer-reviewed reports indicate that those impacts not only can happen, but that their probability is increasing due to unsustainable trends. The assumption for this report is that by creating a better understanding of our scientific knowledge regarding risks with a potentially infinite impact, we can inspire initiatives that can turn these risks into drivers for innovation. Not only could a better understanding of the unique magnitude of these risks help address the risks we face, it could also help to create a path towards more sustainable development. The group of global risks discussed in this report are so different from most of the challenges we face that they are hard to comprehend. But that is also why they can help us to build the collaboration we need and drive the development of further solutions that benefit both people and the planet. As noted above, none of the risks in this report is likely to result directly in an infinite impact, and some are probably even physically incapable of doing so. But all are so significant that they could reach a threshold impact able to create social and ecological instability that could trigger a process which could lead to an infinite impact. For several reasons the potentially infinite impacts of the risks in this report are not as well known as they should be. One reason is the way that extreme impacts are often masked by most of the theories and models used by governments and business today. For example, the probability of extreme impacts is often below what is included in studies and strategies. The tendency to exclude impacts below a probability of five percent is one reason for the relative “invisibility” of infinite impacts. The almost standard use of a 95% confidence interval is one reason why low-probability high-impact events are often ignored.6 Figure 2: Probability density function with tail highlighted [FIGURE 2 OMITTED] Climate change is a good example, where almost all of the focus is on the most likely scenarios and there are few studies that include the low-probability high-impact scenarios. In most reports about climate impacts, the impacts caused by warming beyond five or six degrees Celsius are even omitted from tables and graphs even though the IPCC’s own research indicates that the probability of these impacts are often between one and five percent, and sometimes even higher.7 Other aspects that contribute to this relative invisibility include the fact that extreme impacts are difficult to translate into monetary terms, they have a global scope, and they often require a time-horizon of a century or more. They cannot be understood simply by linear extrapolation of current trends, and they lack historical precedents. There is also the fact that the measures required to significantly reduce the probability of infinite impacts will be radical compared to a business-as-usual scenario with a focus on incremental changes. The exact probability of a specific impact is difficult or impossible to estimate.8 However, the important thing is to establish the current magnitude of the probabilities and compare them with the probabilities for such impacts we cannot accept. A failure to provide any estimate for these risks often results in strategies and priorities defined as though the probability of a totally unacceptable outcome is zero. An approximate number for a best estimate also makes it easier to understand that a great uncertainty means the actual probability can be both much higher and much lower than the best estimate. It should also be stressed that uncertainty is not a weakness in science; it always exists in scientific work. It is a systematic way of understanding the limitations of the methodology, data, etc.9 Uncertainty is not a reason to wait to take action if the impacts are serious. Increased uncertainty is something that risk experts, e.g. insurance experts and security policy experts, interpret as a signal for action. A contrasting challenge is that our cultural references to the threat of infinite impacts have been dominated throughout history by religious groups seeking to scare society without any scientific backing, often as a way to discipline people and implement unpopular measures. It should not have to be said, but this report is obviously fundamentally different as it focuses on scientific evidence from peer-reviewed sources. Infinite impact The concept infinite impact refers to two aspects in particular; the terminology is not meant to imply a literally infinite impact (with all the mathematical subtleties that would imply) but to serve as a reminder that these risks are of a different nature. Ethical These are impacts that threaten the very survival of humanity and life on Earth – and therefore can be seen as being infinitely negative from an ethical perspective. No positive gain can outweigh even a small probability for an infinite negative impact. Such risks require society to ensure that we eliminate these risks by reducing the impact below an infinite impact as a top priority, or at least do everything we can to reduce the probability of these risks. As some of these risks are impossible to eliminate today it is also important to discuss what probability can right now be accepted for risks with a possible infinite impact. Economic Infinite impacts are beyond what most traditional economic models today are able to cope with. The impacts are irreversible in the most fundamental way, so tools like cost-benefit assessment seldom make sense. To use discounting that makes infinite impacts (which could take place 100 years or more from now and affect all future generations) close to invisible in economic assessments, is another example of a challenge with current tools. So while tools like cost-benefit models and discounting can help us in some areas, they are seldom applicable in the context of infinite impacts. New tools are needed to guide the global economy in an age of potential infinite impacts. See chapter 2.2.2 for a more detailed iscussion. Roulette and Russian roulette When probability and normal risks are discussed the example of a casino and roulette is often used. You bet something, then spin the wheel and with a certain probability you win or lose. You can use different odds to discuss different kinds of risk taking. These kinds of thought experiment can be very useful, but when it comes to infinite risks these gaming analogies become problematic. For infinite impact a more appropriate analogy is probably Russian roulette. But instead of “normal” Russian roulette where you only bet your own life you are now also betting everyone you know and everyone you don’t know. Everyone alive will die if you lose. There will be no second chance for anyone as there will be no future generations; humanity will end with your loss. What probability would you accept for different sums of money if you played this version of Russian roulette? Most people would say that it is stupid and – no matter how low the probability is and no matter how big the potential win is – this kind of game should not be played, as it is unethical. Many would also say that no person should be allowed to make such a judgment, as those who are affected do not have a say. You could add that most of those who will lose from it cannot say anything as they are not born and will never exist if you lose. The difference between ordinary roulette and “allhumanity Russian roulette” is one way of illustrating the difference in nature between a “normal” risk that is reversible, and a risk with an infinite impact. An additional challenge in acknowledging the risks outlined in this report is that many of the traditional risks including wars and violence have decreased, even though it might not always looks that way in media.10 So a significant number of experts today spend a substantial amount of time trying to explain that much of what is discussed as dangerous trends might not be as dangerous as we think. For policy makers listening only to experts in traditional risk areas it is therefore easy to get the impression that global risks are becoming less of a problem. The chain of events that could result in infinite impacts in this report also differ from most of the traditional risks, as most of them are not triggered by wilful acts, but accidents/mistakes. Even the probabilities related to nuclear war in this report are to a large degree related to inadvertent escalation. As many of the tools to analyse and address risks have been developed to protect nations and states from attacks, risks involving accidents tend to get less attention. This report emphasises the need for an open and democratic process in addressing global challenges with potentially infinite impact. Hence, this is a scientifically based invitation to discuss how we as a global community can address what could be considered the greatest challenges of our time. The difficulty for individual scientists to communicate a scientific risk approach should however not be underestimated. Scientists who today talk about low-probability impacts, that are serious but still far from infinite, are often accused of pessimism and scaremongering, even if they do nothing but highlight scientific findings.11 To highlight infinite impacts with even lower probability can therefore be something that a scientist who cares about his/her reputation would want to avoid. In the media it is still common to contrast the most probable climate impact with the probability that nothing, or almost nothing, will happen. The fact that almost nothing could happen is not wrong in most cases, but it is unscientific and dangerous if different levels of probability are presented as equal. The tendency to compare the most probable climate impact with the possibility of a low or no impact also results in a situation where low-probability high-impact outcomes are often totally ignored. An honest and scientific approach is to, whenever possible, present the whole probability distribution and pay special attention to unacceptable outcomes. The fact that we have challenges that with some probability might be infinite and therefore fundamentally irreversible is difficult to comprehend, and physiologically they are something our brains are poorly equipped to respond to, according to evolutionary psychologists.12 It is hard for us as individuals to grasp that humanity for the first time in its history now has the capacity to create such catastrophic outcomes. Professor Marianne Frankenhaeuser, former head of the psychology division, Karolinska Institute, Stockholm, put it this way: “Part of the answer is to be found in psychological defence mechanisms. The nuclear threat is collectively denied, because to face it would force us to face some aspects of the world’s situation which we do not want to recognise.” 13 This psychological denial may be one reason why there is a tendency among some stakeholders to confuse “being optimistic” with denying what science is telling us, and ignoring parts of the probability curve.14 Ignoring the fact that there is strong scientific evidence for serious impacts in different areas, and focusing only on selected sources which suggest that the problem may not be so serious, is not optimistic. It is both unscientific and dangerous.15 A scientific approach requires us to base our decisions on the whole probability distribution. Whether it is possible to address the challenge or not is the area where optimism and pessimism can make people look at the same set of data and come to different conclusions. Two things are important to keep in mind: first, that there is always a probability distribution when it comes to risk; second, that there are two different kinds of impacts that are of interest for this report. The probability distribution can have different shapes but in simplified cases the shape tends to look like a slightly modified clock (remember figure 1). In the media it can sound as though experts argue whether an impact, for example a climate impact or a pandemic, will be dangerous or not. But what serious experts discuss is the probability of different oucomes. They can disagree on the shape of the curve or what curves should be studied, but not that a probability curve exists. With climate change this includes discussions about how sensitive the climate is, how much greenhouse gas will be emitted, and what impacts that different warmings will result in. Just as it is important not to ignore challenges with potentially infinite impacts, it is also important not to use them to scare people. Dramatic images and strong language are best avoided whenever possible, as this group of risks require sophisticated strategies that benefit from rational arguments. Throughout history we have seen too many examples when threats of danger have been damagingly used to undermine important values. The history of infinite impacts: The LA-602 document The understanding of infinite impacts is very recent compared with most of our institutions and laws. It is only 70 years ago that Edward Teller, one of the greatest physicists of his time, with his back-of-the-envelope calculations, produced results that differed drastically from all that had gone before. His calculations indicated that the explosion of a nuclear bomb – a creation of some of the brightest minds on the planet, including Teller himself – could result in a chain reaction so powerful that it would ignite the world’s atmosphere, thereby ending human life on Earth.16 Robert Oppenheimer, who led the Manhattan Project to develop the nuclear bomb, halted the project to see whether Teller’s calculations were correct.17 The resulting document, LA- 602: Ignition of the Atmosphere with Nuclear Bombs, concluded that Teller was wrong, But the sheer complexity drove them to end their assessment by writing that “further work on the subject [is] highly desirable”.18 The LA-602 document can be seen as the first scientific global risk report addressing a category of risks where the worst possible impact in all practical senses is infinite.19 Since the atomic bomb more challenges have emerged with potentially infinite impact. Allmost all of these new challenges are linked to the increased knowledge, economic and technical development that has brought so many benefits. For example, climate change is the result of the industrial revolution and development that was, and still is, based heavily on fossil fuel. The increased potential for global pandemics is the result of an integrated global economy where goods and services move quickly around the world, combined with rapid urbanisation and high population density. In parallel with the increased number of risks with possible infinite impact, our capacity to analyse and solve them has greatly increased too. Science and technology today provides us with knowledge and tools that can radically reduce the risks that historically have been behind major extinctions, such as pandemics and asteroids. Recent challenges like climate change, and emerging challenges like synthetic biology and nanotechnology, can to a large degree be addressed by smart use of new technologies, new lifestyles and institutional structures. It will be hard as it will require collaboration of a kind that we have not seen before. It will also require us to create systems that can deal with the problems before they occur. The fact that the same knowledge and tools can be both a problem and a solution is important to understand in order to avoid polarisation. Within a few decades, or even sooner, many of the tools that can help us solve the global challenges of today will come from fields likely to provide us with the most powerful instruments we have ever had – resulting in their own sets of challenges. Synthetic biology, nanotechnology and artificial intelligence (AI) are all rapidly evolving fields with great potential. They may help solve many of today’s main challenges or, if not guided in a benign direction, may result in catastrophic outcomes. The point of departure of this report is the fact that we now have the knowledge, economic resources and technological ability to reduce most of the greatest risks of our time. Conversely, the infinite impacts we face are almost all unintended results of human ingenuity. The reason we are in this situation is that we have made progress in many areas without addressing unintended low-probability high-impact consequences. Creating innovative and resilient systems rather than simply managing risk would let us focus more on opportunities. But the resilience needed require moving away from legacy systems is likely to be disruptive, so an open and transparent discussion is needed regarding the transformative solutions required. Figure 3: Probability density function with tail and threshold highlighted [FIGURE 3 OMITTED] 2.1 Report structure The first part of the report is an introduction where the global risks with potential infinite impact are introduced and defined. This part also includes the methodology for selecting these risks, and presents the twelve risks that meet this definition. Four goals of the report are also presented, under the headings “acknowledge”, “inspire”, “connect” and “deliver”. The second part is an overview of the twelve global risks and key events that illustrate some of the work around the world to address them. For each challenge five important factors that influence the probability or impact are also listed. The risks are divided into four different categories depending on their characteristics. “Current challenges” is the first category and includes the risks that currently threaten humanity due to our economic and technological development - extreme climate change, for example, which depends on how much greenhouse gas we emit. “Exogenic challenges” includes risks where the basic probability of an event is beyond human control, but where the probability and magnitude of the impact can be influenced - asteroid impacts, for example, where the asteroids’ paths are beyond human control but an impact can be moderated by either changing the direction of the asteroid or preparing for an impact. “Emerging challenges” includes areas where technological development and scientific assessment indicate that they could both be a very important contribution to human welfare and help reduce the risks associated with current challenges, but could also result in new infinite impacts.20 AI, nanotechnology and synthetic biology are examples. “Global policy challenge” is a different kind of risk. It is a probable threat arising from future global governance as it resorts to destructive policies, possibly in response to the other challenges listed above. The third part of the report discusses the relationship between the different risks. Action to reduce one risk can increase another, unless their possible links are understood. Many solutions are also able to address multiple risks, so there are significant benefits from understanding how one relates to others. Investigating these correlations could be a start, but correlation is a linear measure and non-linear techniques may be more helpful for assessing the aggregate risk. The fourth part is an overview, the first ever to our knowledge, of the uncertainties and probabilities of global risks with potentially infinite impacts. The numbers are only rough estimates and are meant to be a first step in a dialogue where methodologies are developed and estimates refined. The fifth part presents some of the most important underlying trends that influence the global challenges, which often build up slowly until they reach a threshold and very rapid changes ensue. The sixth and final part presents an overview of possible ways forward. 2.2 Goals Goal 1: Acknowledge That key stakeholders, influencing global challenges, acknowledge the existence of the category of risks that could result in infinite impact. They should also recognice that the list of risks that belong to this category should be revised as new technologies are developed and our knowledge increases. Regardless of the risks included, the category should be given special attention in all processes and decisions of relevance. The report also seeks to demonstrate to all key stakeholders that we have the capacity to reduce, or even eliminate, most of the risks in this category. Establish a category of risks with potentially infinite impact. Before anything significant can happen regarding global risks with potentially infinite impacts, their existence must be acknowledged. Rapid technological development and economic growth have delivered unprecedented material welfare to billions of people in a veritable tide of utopias.21 But we now face the possibility that even tools created with the best of intentions can have a darker side too, a side that may threaten human civilisation, and conceivably the continuation of human life. This is what all decision-makers need to recognise. Rather than succumbing to terror, we need to acknowledge that we can let the prospect inspire and drive us forward. Goal 2: Inspire That policy makers inspire action by explaining how the probabilities and impacts can be reduced and turned into opportunities. Concrete examples of initiatives should be communicated in different networks in order to create ripple effects, with the long-term goal that all key stakeholders should be inspired to turn these risks into opportunities for positive action. Show concrete action that is taking place today. This report seeks to show that it is not only possible to contribute to reducing these risks, but that it is perhaps the most important thing anyone can spend their time on. It does so by combining information about the risks with information about individuals and groups who has made a significant contribution by turning challenges into opportunities. By highlighting concrete examples the report hopes to inspire a new generation of leaders. Goal 3: Connect That leaders in different sectors connect with each other to encourage collaboration. A specific focus on financial and security policy where significant risks combine to demand action beyond the incremental is required. Support new meetings between interested stakeholders. The nature of these risks spans countries and continents; they require action by governments and politicians, but also by companies, academics, NGOs, and many other groups. The magnitude of the possible impacts requires not only leaders to act but above all new models for global cooperation and decision-making to ensure delivery. The need for political leadership is therefore crucial. Even with those risks where many groups are involved, such as climate change and pandemics, very few today address the possibility of infinite impact aspects. Even fewer groups address the links between the different risks. There is also a need to connect different levels of work, so that local, regional, national and international efforts can support each other when it comes to risks with potentially infinite impacts. Goal 4: Deliver That concrete strategies are developed that allow key stakeholders to identify, quantify and address global challenges as well as gather support for concrete steps towards a wellfunctioning global governance system. This would include tools and initiatives that can help identify, quantify and reduce risks with potentially infinite impacts. Identify and implement strategies and initiatives. Reports can acknowledge, inspire and connect, but only people can deliver actual results. The main focus of the report is to show that actual initiatives need to be taken that deliver actual results. Only when the probability of an infinite impact becomes acceptably low, very close to zero, and/or when the maximum impact is significantly reduced, should we talk about real progress. In order to deliver results it is important to remember that global governance to tackle these risks is the way we organise society in order to address our greatest challenges. It is not a question of establishing a “world government”, it is about the way we organise ourselves on all levels, from the local to the global. The report is a first step and should be seen as an invitation to all responsible parties that can affect the probability and impact of risks with potentially infinite impacts. But its success will ultimately be measured only on how it contributes to concrete results. 2.3 Global challenges and infinite impact This chapter first introduces the concept of infinite impact. It then describes the methodology used to identify challenges with an infinite impact. It then presents risks with potentially infinite impact that the methodology results in. 2.3.1 Definition of infinite impact The specific criterion for including a risk in this report is that well-sourced science shows the challenge can have the following consequences: 22 1. Infinite impact: When civilisation collapses to a state of great suffering and does not recover, or a situation where all human life ends. The existence of such threats is well attested by science.23 2. Infinite impact threshold – an impact that can trigger a chain of events that could result first in a civilisation collapse, and then later result in an infinite impact. Such thresholds are especially important to recognise in a complex and interconnected society where resilience is decreasing.24 A collapse of civilisation is defined as a drastic decrease in human population size and political/economic/social complexity, globally for an extended time.25 The above definition means the list of challenges is not static. When new challenges emerge, or current ones fade away, the list will change. An additional criterion for including risks in this report is “human influence”. Only risks where humans can influence either the probability, the impact, or both, are included. For most risks both impact and probability can be affected, for example with nuclear war, where the number/size of weapons influences the impact and tensions between countries affects the probability. Other risks, such as a supervolcano, are included as it is possible to affect the impact through various mitigation methods, even if we currently cannot affect the probability. Risks that are susceptible to human influence are indirectly linked, because efforts to address one of them may increase or decrease the likelihood of another. 2.3.2 Why use “infinite impact” as a concept? The concept of infinity was chosen as it reflects many of the challenges, especially in economic theory, to addressing these risks as well as the need to question much of our current way of thinking. The concept of a category of risks based on their extreme impact is meant to provide a tool to distinguish one particular kind of risk from others. The benefit of this new concept should be assessed based on two things. First, does the category exist, and second, is the concept helpful in addressing these risks? The report has found ample evidence that there are risks with an impact that can end human civilisation and even all human life. The report further concludes that a new category of risk is not only meaningful but also timely. We live in a society where global risks with potentially infinite impacts increase in both number and probability according to multiple studies. Looking ahead, many emerging technologies which will certainly provide beneficial results, might also result in an increased probability of infinite impacts.26 Over the last few years a greater understanding of low probability or unknown probability events has helped more people to understand the importance of looking beyond the most probable scenarios. Concepts like “black swans” and “perfect storms” are now part of mainstream policy and business language.27 Greater understanding of the technology and science of complex systems has also resulted in a new understanding of potentially disruptive events. Humans now have such an impact on the planet that the term “the anthropocene” is being used, even by mainstream media like The Economist.28 The term was introduced in the 90s by the Nobel Prize winner Paul Crutzen to describe how humans are now the dominant force changing the Earth’s ecosystems.29 The idea to establish a well defined category of risks that focus on risks with a potentially infinite impact that can be used as a practical tool by policy makers is partly inspired by Nick Bostrom’s philosophical work and his introduction of a risk taxonomy that includes an academic category called “existential risks”.30 Introducing a category with risks that have a potentially infinite impact is not meant to be a mathematical definition; infinity is a thorny mathematical concept and nothing in reality can be infinite.31 It is meant to illustrate a singularity, when humanity is threatened, when many of the tools used to approach most challenges today become problematic, meaningless, or even counterproductive. The concept of an infinite impact highlights a unique situation where humanity itself is threatened and the very idea of value and price collapses from a human perspective, as the price of the last humans also can be seen to be infinite. This is not to say that those traditional tools cannot still be useful, but with infinite impacts we need to add an additional set of analytical tools. Life Value The following estimates have been applied to the value of life in the US. The estimates are either for one year of additional life or for the statistical value of a single life. – $50,000 per year of quality life (international standard most private and government-run health insurance plans worldwide use to determine whether to cover a new medical procedure) – $129,000 per year of quality life (based on analysis of kidney dialysis procedures by Stefanos Zenios and colleagues at Stanford Graduate School of Business) – $7.4 million (Environmental Protection Agency) – $7.9 million (Food and Drug Administration) – $6 million (Transportation Department) – $28 million (Richard Posner based on the willingness to pay for avoiding a plane crash) Source: Wikipedia: Value of life http://en.wikipedia.org/wiki/Value\_of\_life US EPA: Frequently Asked Questions on Mortality Risk Valuation http://yosemite.epa.gov/EE%5Cepa%5Ceed.nsf/webpages/MortalityRiskValuation.html Posner, Richard A. Catastrophe: risk and response. Oxford University Press, 2004 Some of the risks, including nuclear war, climate change and pandemics, are often included in current risk overviews, but in many cases their possible infinite impacts are excluded. The impacts which are included are in most cases still very serious, but only the more probable parts of the probability distributions are included, and the last part of the long tail – where the infinite impact is found – is excluded.32 Most risk reports do not differentiate between challenges with a limited impact and those with a potential for infinite impact. This is dangerous, as it can mean resources are spent in ways that increase the probability of an infinite impact. Ethical aspects of infinite impact The basic ethical aspect of infinite impact is this: a very small group alive today can take decisions that will fundamentally affect all future generations. “All future generations” is not a concept that is often discussed, and for good reason. All through human history we have had no tools with a measurable global impact for more than a few generations. Only in the last few decades has our potential impact reached a level where all future generations can be affected, for the simple reason that we now have the technological capacity to end human civilisation. If we count human history from the time when we began to practice settled agriculture, that gives us about 12,000 years.33 If we make a moderate assumption that humanity will live for at least 50 million more years34 our 12,000-year history so far represents 1/4200, or 0.024%, of our potential history. So our generation has the option of risking everything and annulling 99.976% of our potential history. Comparing 0.024% with the days of a person living to 100 years from the day of conception, this would equal less than nine days and is the first stage of human embryogenesis, the germinal stage.35 Two additional arguments to treat potentially infinite impacts as a separate category are: 36 1. An approach to infinite impacts cannot be one of trial-and-error, because there is no opportunity to learn from errors. The reactive approach – see what happens, limit damage, and learn from experience – is unworkable. Instead society must be proactive. This requires foresight to foresee new types of threat and willingness to take decisive preventative action and to bear the costs (moral and economic) of such actions. 2. We cannot necessarily rely on the institutions, morality, social attitudes or national security policies that developed from our experience of other sorts of risk. Infinite impacts are in a different category. Institutions and individuals may find it hard to take these risks seriously simply because they lie outside our experience. Our collective fear-response will probably be ill-calibrated to the magnitude of threat. Economic aspects of infinite impact and discounting In today’s society a monetary value is sometimes ascribed to human life. Some experts use this method to estimate risk by assigning a monetary value to human extinction.37 We have to remember that the monetary values placed on a human life in most cases are not meant to suggest that we have actually assigned a specific value to a life. Assigning a value to a human life is a tool used in a society with a limited supply of resources or infrastructure (ambulances, perhaps) or skills. In such a society it is impossible to save every life, so some trade-off must be made.38 The US Environmental Protection Agency explains its use like this: “The EPA does not place a dollar value on individual lives. Rather, when conducting a benefit-cost analysis of new environmental policies, the Agency uses estimates of how much people are willing to pay for small reductions in their risks of dying from adverse health conditions that may be caused by environmental pollution.” 39 The fact that monetary values for human lives can help to define priorities when it comes to smaller risks does not mean that they are suitable for quite different uses. Applying a monetary value to the whole human race makes little sense to most people, and from an economic perspective it makes no sense. Money helps us to prioritise, but with no humans there would be no economy and no need for priorities. Ignoring, or discounting, future generations is actually the only way to avoid astronomical numbers for impacts that may seriously affect every generation to come. In Catastrophe: Risk and Response, Richard Posner provides a cost estimate, based on the assumption that a human life is worth $50,000, resulting in a $300 tn cost for the whole of humanity, assuming a population of six billion. He then doubles the population number to include the value of all future generations, ending up with $600 tn, while acknowledging that “without discounting, the present value of the benefits of risk-avoidance measures would often approach infinity for the type of catastrophic risk with which this book is concerned.” 40 Discounting for risks that include the possibility of an infinite impact differs from risk discounting for less serious impacts. For example the Stern Review41 prompted a discussion between its chief author, Nicholas Stern, and William Nordhaus,42 each of whom argued for different discount levels using different arguments. But neither discussed a possible infinite climate impact. An overview of the discussion by David Evans of Oxford Brookes University highlighted some of the differing assumptions.43 Two things make infinite impacts special from a discounting perspective. First, there is no way that future generations can compensate for the impact, as they will not exist. Second, the impact is something that is beyond an individual preference, as society will no longer exist. Discounting is undertaken to allocate resources in the most productive way. In cases that do not include infinite impacts, discounting “reflects the fact that there are many high-yield investments that would improve the quality of life for future generations. The discount rate should be set so that our investable funds are devoted to the most productive uses.” 44 When there is a potentially infinite impact, the focus is no longer on what investments have the best rate of return, it is about avoiding the ultimate end. While many economists shy away from infinite impacts, those exploring the potentially extreme impacts of global challenges often assume infinite numbers to make their point. Nordhaus for example writes that “the sum of undiscounted anxieties would be infinite (i.e. equal to 1 + 1 +1 + … = ∞). In this situation, most of us would dissolve in a sea of anxiety about all the things that could go wrong for distant generations from asteroids, wars, out-of-control robots, fat tails, smart dust and other disasters.” 45 It is interesting that Nordhaus himself provides very good graphs that show why the most important factor when determining actions is a possible threshold (see below Figure 4 and 5). Nordhaus was discussing climate change, but the role of thresholds is similar for most infinite impacts. The first figure is based on traditional economic approaches which assume that Nature has no thresholds; the second graph illustrates what happens with the curve when a threshold exists. As Nordhaus also notes, it is hard to establish thresholds, but if they are significant all other assumptions become secondary. The challenge that Nordhaus does not address, and which is important especially with climate change, is that thresholds become invisible in economic calculations if they occur far into the future, even if it is current actions that unbalance the system and eventually push it over the threshold.46 Note that these dramatic illustrations rest on assumptions that the thresholds are still relatively benign, not moving us beyond tipping points which result in an accelerated release of methane that could result in a temperature increase of more than 8 °C, possibly producing infinite impacts.47 Calculating illustrative numbers By including the welfare of future generations, something that is important when their very existence is threatened, economic discounting becomes difficult. In this chapter, some illustrative numbers are provided to indicate the order of magnitude of the values that calculations provide when traditional calculations also include future generations. These illustrative calculations are only illustrative as the timespans that must be used make all traditional assumptions questionable to say the least. Still, as an indicator for why infinite impact might be a good approximation they might help. As a species that can manipulate our environment it could be argued that the time the human race will be around, if we do not kill ourselves, can be estimated to be between 1-10 million years – the typical time period for the biological evolution of a successful species48 – and one billion years, the inhabitable time of Earth.49 [FIGURE 4 OMITTED] [FIGURE 5 OMITTED] If we assume – 50 million years for the future of humanity as our reference, – an average life expectancy of 100 years50, and – a global population of 6 billion people51 – all conservative estimate – , we have half a million generations ahead of us with a total of 3 quadrillion individuals. Assuming a value of $50,000 per life, the cost of losing them would then be $1.5 ×1020, or $150 quintillion. This is a very low estimate, and Posner suggests that maybe the cost of a life should be “written up $28 million” for catastrophic risks52. Posner’s calculations where only one future generation is included result in a cost of $336 quadrillion. If we include all future generations with the same value, $28 million, the result is a total cost of $86 sextillion, or $86 × 1021. This $86 sextillion is obviously a very rough number (using one billion years instead of 50 million would for example require us to multiply the results by 20), but again it is the magnitude that is interesting. As a reference there are about 1011 to 1012 stars in our galaxy, and perhaps something like the same number of galaxies. With this simple calculation you get 1022 to 1024, or 10 to 1,000 sextillion, stars in the universe to put the cost of infinite impacts when including future generations in perspective.53 These numbers can be multiplied many times if a more philosophical and technology-optimistic scenario is assumed for how many lives we should include in future generations. The following quote is from an article by Nick Bostrom in Global Policy Journal: “However, the relevant figure is not how many people could live on Earth but how many descendants we could have in total. One lower bound of the number of biological human life-years in the future accessible universe (based on current cosmological estimates) is 1034 years. Another estimate, which assumes that future minds will be mainly implemented in computational hardware instead of biological neuronal wetware, produces a lower bound of 1054 human-brain-emulation subjective life-years.” 54 Likewise the value of a life, $28 million, a value that is based on an assessment of how individuals chose when it comes to flying, can be seen as much too small. This value is based on how much we value our own lives on the margin, and it is reasonable to assume that the value would be higher than only a multiplication of our own value if we also considered the risk of losing our family, everyone we know, as well as everyone else on the planet. In the same way as the cost increases when a certain product is in short supply, the cost of the last humans could be assumed to be very high, if not infinite. Obviously, the very idea to put a price on the survival of humanity can be questioned for good reasons, but if we still want to use a number, $28 million per life should at least be considered as a significant underestimation. For those that are reluctant or unable to use infinity in calculations and are in need of a number for their formulas, $86 sextillion could be a good initial start for the cost of infinite impacts. But it is important to note that this number might be orders of magnitude smaller than an estimate which actually took into account a more correct estimation of the number of people that should be included in future generations as well as the price that should be assigned to the loss of the last humans. 2.3.3 Infinite impact threshold (IIT) As we address very complex systems, such as human civilisation and global ecosystems, a concept as important as infinite impact in this report is that of infinity impact threshold. This is the impact level that can trigger a chain of events that results in the end of human civilisation. The infinite impact threshold (IIT) concept represents the idea that long before an actual infinite impact is reached there is a tipping point where it (with some probability) is no longer possible to reverse events. So instead of focusing only on the ultimate impact it is important to estimate what level of impact the infinity threshold entails. The IIT is defined as an impact that can trigger a chain of events that could result first in a civilisation collapse, and then later result in an infinite impact. Such thresholds are especially important to recognise in a complex and interconnected society where resilience is decreasing. Social and ecological systems are complex, and in most complex systems there are thresholds where positive feedback loops become self-reinforcing. In a system where resilience is too low, feedback loops can result in a total system collapse. These thresholds are very difficult to estimate and in most cases it is possible only to estimate their order of magnitude. As David Orrell and Patrick McSharry wrote in A Systems Approach to Forecasting: “Complex systems have emergent properties, qualities that cannot be predicted in advance from knowledge of systems components alone”. According to complexity scientist Stephen Wolfram’s principle of computational irreducibility, the only way to predict the evolution of such a system is to run the system itself: “There is no simple set of equations that can look into its future.” 55 Orrell and McSharry also noted that “in orthodox economics, the reductionist approach means that the economy is seen as consisting of individual, independent agents who act to maximise their own utility. It assumes that prices are driven to a state of near-equilibrium by the ‘invisible hand’ of the economy. Deviations from this state are assumed to be random and independent, so the price fluctuations are often modelled using the normal distribution or other distributions with thin tails and finite variance.” The drawbacks of an approach using the normal distribution, or other distributions with thin tails and finite variance, become obvious when the unexpected happens as in the recent credit crunch, when existing models totally failed to capture the true risks of the economy. As an employee of Lehman Brothers put it on August 11, 2007: “Events that models predicted would happen only once in 10,000 years happened every day for three days.” 56 [FIGURE 6 OMITTED] The exact level for an infinite impact threshold should not be the focus, but rather the fact that such thresholds exists and that an order of magnitude should be estimated.57 During the process of writing the report, experts suggested that a relatively quick death of two billion people could be used as a tentative number until more research is available.58 With current trends undermining ecological and social resilience it should be noted that the threshold level is likely to become lower as time progress. 2.3.4 Global F-N curves and ALARP In the context of global risks with potentially infinite impact, the possibility of establishing global F-N curves is worth exploring. One of the most common and flexible frameworks used for risk criteria divides risks into three bands: 59 1. Upper: an unacceptable/ intolerable region, where risks are intolerable except in extraordinary circumstances and risk reduction measures are essential. 2. Middle: an ALARP (“as low as reasonably practicable”) region, where risk reduction measures are desirable but may not be implemented if their cost is disproportionate to the benefit achieved. 3. Lower: a broadly acceptable/ negligible region, where no further risk reduction measures are needed. The bands are expressed by F-N curves. When the frequency of events which cause at least N fatalities is plotted against the number N on log–log scales, the result is called an F-N curve.60 If the frequency scale is replaced by annual probability, then the resultant curve is called an f-N curve. The concept for the middle band when using F-N curves is ALARP. It is a term often used in the area of safety-critical and safety-involved systems.62 The ALARP principle is that the residual risk should be as low as reasonably practicable. The upper band, the unacceptable/ intolerable region, is usually the area above the ALARP area (see figure 8) By using F-N curves it is also possible to establish absolute impact levels that are never acceptable, regardless of probability (Figure 7. Based on an actual F-n Curve showing an absolute impact level that is defined as unacceptable). This has been done in some cases for local projects. The infinite threshold could be used to create an impact limit on global F-N curves used for global challenges in the future. Such an approach would help governments, companies and researchers when they develop new technical solutions and when investing in resilience. Instead of reducing risk, such an approach encourages the building of systems which cannot have negative impacts above a certain level. Pros – Clearly shows relationship between frequency and size of accident – Allows judgement on relative importance of different sizes of accident – Slope steeper than -1 provides explicit consideration of multiple fatality aversion and favours concepts with lower potential for large fatality events – Allows company to manage overall risk exposure from portfolio of all existing and future facilities Cons – Cumulative expression makes it difficult to interpret, especially by non-risk specialists – Can be awkard to derive – May be difficult to use if criterion is exceeded in one area but otherwise is well below – Much debate about criterion lines Figure 7: Example of F-n curve showing different levels of risk 61 Figure 9: Pros and cons of F-N curves 63 46 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 2.3 Global challenges and infinite impact practical guidance that can provide defined group of risks 2.3.5 A name for a clearly 10 100 1000 10000 10 10 10 10 10 10 10 10-2 -3 -4 -5 -6 -7 -8 -9 Number of Fatalities (N) Frequency (F) of Accidents with N or More Fatalities (Per Year) ALARP region Unacceptable Acceptable Today no established methodology exists that provides a constantly updated list of risks that threaten human civilisation, or even all human life. Given that such a category can help society to better understand and act to avoid such risks, and better understand the relation between these risks, it can be argued that a name for this category would be helpful.65 To name something that refers to the end of humanity is in itself a challenge, as the very idea is so far from our usual references and to many the intuitive feeling will be to dismiss any such thing. The concept used in this report is “infinity”. The reson for this is that many of the challenges relate to discussed. In one way the name is not very important so long as people understand the impacts and risks associated with it. Still, a name is symbolic and can either help or make it more difficult to get support to establish the new category. The work to establish a list of risks with infinite impact evolved from “existential risk”, the philosophical concept that inspired much of the work to establish a clearly defined group of risks. The reason for not using the concept “existential risk and impact” for this category, beside the fact that existential impact is also used in academic contexts to refer to a personal impact, is that the infinite category is a smaller subset of “existential risk” and this new category is meant to be used as a tool, not a scientific concept. Not only should the impacts in the category potentially result in the end of all human life, it should be possible to affect the probability and/or impact of that risk. There must also exist an agreed methodology, such as the one suggested in this report, that decides what risks belong and not belong on the list. Another concept that the category relates to is “global catastrophic risk” as it is one of the most used concepts among academics interested in infinite impacts. However it is vague enough to be used to refer to impacts from a few thousand deaths to the end of human civilisation. Already in use but not clearly defined, it includes both the academic concept existential risks and the category of risks with infinite impacts. macroeconomics and its challenges in relation to the kind of impacts that the risks in this report focus on. Further, the name clearly highlights the unique nature without any normative judgements. Still, infinity is an abstract concept and it might not be best communicate the unique group of risks that it covers to all stakeholders. In the same way as it can be hard to use singularity to describe a black hole, it can be difficult to use infinity to describe a certain risk. If people can accept that it is only from a specific perspective that the infinity concept is relevant it could be used beyond the areas of macroeconomics. Two other concepts that also have been considered during the process of writing this report are “xrisks” and “human risk of ruin”. Xrisk has the advantage, and disadvantage, of not really saying anything at all about the risk. The positive aspect is that the name can be associated with the general concept of extinction and the philosophical concept of existential risk as both have the letter x in them. The disadvantage is the x often represents the unknown and can therefore relate to any risk. There is nothing in the name that directly relates to the kind of impacts that the category covers, so it is easy to interpret the term as just unknown risks. Human risk of ruin has the advantage of having a direct link to a concept, risk of ruin, that relates to a very specific state where all is lost. Risk of ruin is a concept in use in gambling, insurance, and finance that can all give very important contributions to the work with this new category of risk. The resemblance to an existing concept that is well established could be both a strength and a liability. Below is an overview of the process when different names were Figure 8: Example of F-n curve showing an absolute impact level that is defined as unacceptable/ infinite. i.e no level of probability is acceptable above a certain level of impact, in this case 1000 dead 64 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 47 2.3 Global challenges and infinite impact 3. 2. 1. 9. Unacceptable risks in different combinations, e.g. unacceptable global risks – This is probably not appropriate for two main reasons. First, it is a normative statement and the category aims to be scientific; whether these risks are unacceptable or not is up to the citizens of the world to decide. Second, the idea of risk is that it is a combination of probability times impact. If a risk is unacceptable is therefore also usually related to how easy it is to avoid. Even if a risk is small, due to relatively low probability and relatively low impact, but is very easy to address, it can be seen as unacceptable, in the same way a large risk can be seen as acceptable if it would require significant resources to reduce. There will not be a perfect concept and the question is what concept can find the best balance between being easy to understand, acceptable where policy decisions needs to be made and also acceptable for all key groups that are relevant for work in these area. During the process to find a name for this category inspiration has been found in the process when new concepts have been introduced; from irrational numbers and genocide to sustainable development and the Human Development Index. So far “infinite risk” can be seen as the least bad concept in some areas and “xrisks” and “human risk of ruin” the least bad in others. The purpose of this report is to establish a methodology to identify a very specific group of risks as well as continue to a process where these risks will be addressed in a systematic and appropriate way. The issue of naming this group of risks will be left to others. The important is that the category gets the attention it deserves. The three concepts are very different. Global catastrophic risk is possibly the most used concept in contexts where infinite impacts are included, but it is without any clear definition. Existential risk is an academic concept used by a much smaller group and with particular focus on future technologies. The category in this report is a tool to help decision makers develop strategies that help reduce the probability that humanity will end when it can be avoided. The relation between the three concepts can be illustrated with three circles. The large circle (1) represents global catastrophic risks, the middle one (2) existential risks and the small circle (3) the list of twelve risks in this report, i.e. risks where there are peer reviewed academic studies that estimate the probability of an infinite impact and where there are known ways to reduce the risk. A list that could be called infinite risks, xrisks, or human risk of ruin. Other concepts that are related to infinite impacts that could potentially be used to describe the same category if the above suggestions are not seen as acceptable concepts are presented below, together with the main reason why these concepts were not chosen for this report. 1. Risk of ruin – is a concept in gambling, insurance and finance relating to the likelihood of losing all one’s capital or affecting one’s bankroll beyond the point of recovery. It is used to describe individual companies rather than systems.66 2. Extinction risk – is used in biology for any species that is threatened. The concept is also used in memory/cognition research. It is a very dramatic term, to be used with care. These factors make it probably unsuitable for use by stakeholders accustomed to traditional risk assessment. 3. Astronomical risk – is seldom used scientifically, but when it is used it is often used for asteroids and is probably best reserved for them.67 4. Apocalyptic risk – could have been suitable, as the original meaning is apocálypsis, from the Greek ἀπό and καλύπτω meaning ‘un-covering’. It is sometime used, but in a more general sense, to mean significant risks.68 But through history and today it is mainly used for a religious end of time scenario. Its strong links to unscientific doom-mongers make it probably unsuitable for a scientific concept. 5. End-of-the-world risk - belongs to the irrational doomsday narratives and so is probably unsuitable for scientific risk assessments. 6. Extreme risk – is vague enough to describe anything beyond the normal, so it is probably unsuitable for risk assessments of this magnitude. 7. Unique risk – is even vaguer, as every risk is unique in some way. Probably best avoided in risk assessments. 8. Collapse risk – is based on Jared Diamond’s thinking.69 There are many different kinds of collapse and only a few result in infinite impact. 48 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 2.3 Global challenges and infinite impact Estimations of impact Only literature where there is some estimation of impact that indicates the possibility of an infinite impact is included. Leading organisations’ priorities In order to increase the probability of covering all relevant risks an overview of leading organisations' work was conducted. This list was then compared with the initial list and subjected to the same filter regarding the possibility to affect the probability or impact. Possibility of addressing the risk Possibility of addressing the risk: From the risks gathered from literature and organisations, only those where the probability or impact can be affected by human actions are included. Expert review Qualitative assessment: Expert review in order to increase the probability of covering all relevant global risks. List of risks Result: List of risks with potentially infinite impacts. Relevant literature Identification of credible sources: search relevant literature in academic literature included in World of Knowledge and Google Scholar. 1 2 3 4 5 6 This chapter presents the methodology used to identify global risks with potentially infinite impact. Methodology overview In order to establish a list of global risks with potentially infinite impact a methodological triangulation was used, consisting of: – A quantitative assessment of relevant literature. – A strategic selection of relevant organisations and their priorities. – A qualitative assessment with the help of expert workshops. 2.4 Methodology 70 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 49 2.4 Methodology The scientific review of literature was led by Seth Baum, Executive Director of the Global Catastrophic Risk Institute72 and research scientist at the Center for Research on Environmental Decisions, Columbia University.73 The methodology for including global risks with a potentially infinite impact is based on a scientific review of key literature, with focus on peer-reviewed academic journals, using keyword search of both World of Knowledge74 and Google Scholar75 combined with existing literature overviews in the area of global challenges. This also included a snowball methodology where references in the leading studies and books were used to identify other scientific studies and books. In order to select words for a literature search to identify infinite impacts, a process was established to identify words in the scientific literature connected to global challenges with potentially infinite impacts. Some words generate a lot of misses, i.e. publications that use the term but are not the focus of this report. For example “existential risk” is used in business; “human extinction” is used in memory/cognition. Some search terms produced relatively few hits. For example “global catastrophic risk” is not used much. Other words are only used by people within a specific research community: few use “existential risk” in our sense unless they are using Nick Bostrom’s work. The term “global catastrophe” was identified as a phrase that referred almost exclusively to extremely negative impacts on humans, by a diversity of researchers, not just people in one research community. A list of 178 relevant books and reports was established based on what other studies have referred to, and/or which are seen as landmark studies by groups interviewed during the process. They were selected for a closer examination regarding the challenges they include.76 The full bibliography, even with its focus on publications of general interest, is still rather long. So it is helpful to have a shorter list focused on the highlights; the most important publications based on how often they are quoted, how wellspread the content (methodology, lists, etc.) is and how often key organisations use them. The publications included must meet at least one of the following criteria: – Historical significance. This includes being the first publication to introduce certain key concepts, or other early discussions of global challenges. Publications of historical significance are important for showing the intellectual history of global challenges. Understanding how the state of the art research got to where it is today can also help us understand where it might go in the future. – Influential in developing the field. This includes publications that are highly cited77 and those that have motivated significant additional research. They are not necessarily the first publications to introduce the concepts they discuss, but for whatever reason they will have proved important in advancing research. – State of the art. This includes publications developing new concepts at the forefront of global challenges research as well as those providing the best discussions of important established concepts. Reading these publications would bring a researcher up to speed with current research on global challenges. So they are important for the quality of their ideas. – Covers multiple global challenges (at least two). Publications that discuss a variety of global challenges are of particular importance because they aid in identifying and comparing the various challenges. This process is essential for research on global risks to identify boundaries and research priorities. In order to identify which global challenges are most commonly discussed, key surveys were identified and coded. First, a list of publications that survey at least three global challenges was compiled, and they were then scanned to find which challenges they discussed. The publications that survey many global challenges were identified from the full bibliography. Publications from both the academic and popular literature were considered. Emphasis was placed on publications of repute or other significance.78 To qualify as a survey of global challenges, the publication had to provide an explicit list of challenges or to be of sufficient length and breadth for it to discuss a variety of challenges. Many of the publications are books or book-length collections of articles published in book form or as special issues of scholarly journals. Some individual articles were also included because they discussed a significant breadth of challenges. A total of 40 global challenge survey publications were identified. For authors with multiple entries (Bostrom with three and WEF with ten) each challenge was counted only once to avoid bias. review of key literature 71 2.4.1 A scientific 50 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 2.4 Methodology 0 5 10 15 20 25 Climate Change Nuclear War Pandemic Biodiversity loss Asteroid / Comet / Meteor Volcano Genetic Engineering High Energy Physics Nanotech Resource Depletion Artificial Intelligence Chemical Pollution Ecological Catastrophe Biogeochem Government Failure Poverty System Failure Astronomic Explosion LULCC Biological Weapons Chemical Weapons Extraterrestrial Reject Procreation Computer Failure EM Pulse New Technology Ozone Depletion Dysgenics Ocean Acidification Interstellar Cloud Atmosphere Aerosols Phase Transition Simulation Unknown 21 18 17 15 14 14 13 13 13 13 11 11 11 8 8 8 8 7 7 5 5 5 5 4 4 4 4 3 3 2 1 1 1 1 In terms of authorship and audience, there are 17 academic publications, 9 popular publications, 1 government report, 3 publications written by academics for popular audiences. In terms of format, there are 15 books, 5 edited collections, 7 articles, 3 of miscellaneous format. Of the 40 publications identified, 22 were available at the time of coding. In addition, 10 Global Risks Reports from the World Economic Forum were coded and then gathered under one heading: “WEF Global Risk Report 2005-2014”. A list of 34 global challenges was developed based on the challenges mentioned in the publications. A spreadsheet containing the challenges and the publications was created to record mentions of specific challenges in each publication to be coded. Then each publication was scanned in its entirety for mentions of global challenges. Scanning by this method was necessary because many of the publications did not contain explicit lists of global challenges, and the ones that did often mentioned additional challenges separately from their lists. So it was not required that a global challenge be mentioned in a list for it to be counted – it only had to be mentioned somewhere in the publication as a challenge. Assessing whether a particular portion of text counts as a global challenge and which category it fits in sometimes requires some interpretation. This is inevitable for most types of textual analysis, or, more generally, for the coding of qualitative data. The need for interpretation in this coding was heightened by the fact that the publications often were not written with the purpose of surveying the breadth of global challenges, and even the publications that were intended as surveys did not use consistent definitions of global challenges. The coding presented here erred on the side of greater inclusivity: if a portion of text was in the vicinity of a global challenge, then it was coded as one. For example, some publications discussed risks associated with nuclear weapons in a general sense without specifically mentioning the possibility of large-scale nuclear war. These discussions were coded as mentions of nuclear war, even though they could also refer to single usages of nuclear weapons that would not rate as a global challenge. This more inclusive approach is warranted because many of the publications were not focused exclusively on global challenges. If they were focused on them, it is likely that they would have included these risks in their global challenge form (e.g., nuclear war), given that they were already discussing something related (e.g., nuclear weapons). Below are the results from the overview of the surveys. Figure 9: Number of times global challenges are included in surveys of global challenges Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 51 2.4 Methodology Climate Change Nuclear War Pandemic Biodiversity loss Asteroid / Comet / Meteor Volcano Genetic Engineering High Energy Physics Nanotech Resource Depletion Artificial Intelligence Chemical Pollution Ecological Catastrophe 21 18 17 15 14 14 13 13 13 13 11 11 11 0 25 20 15 10 5 dung beetle star trek zinc oxalate human extinction 0 200 400 600 800 1000 It should be noted that the literature that includes multiple global challenges with potentially infinite impact is very small, given the fact that it is about the survival of the human race. Experts in the field of global challenges, like Nick Bostrom, have urged policymakers and donors to focus more on the global challenges with infinite impacts and have used dramatic rhetoric to illustrate how little research is being done on them compared with other areas. However, it is important to note that many more studies exist that focus on individual global risks, but often without including low-probability high-impact outcomes.80 How much work actually exists on human extinction infinite impact is therefore difficult to assess. The list of risks found in the scientific literature was checked against a review of what challenges key organisations working on global challenges include in their material and on their webpages. This was done to ensure that no important risk was excluded from the list. The coding of key organisations paralleled the coding of key survey publications. Organisations were identified via the global catastrophic risk organisation directory published by the Global Catastrophic Risk Institute.82 They were selected from the directory if they worked on a variety of global challenges – at least three, and ideally more. The reason for focusing on those that work on multiple challenges is to understand which challenges they consider important and why. In contrast, organisations that focus on only one or two challenges may not Figure 10: The global challenges included ten times or more in surveys of global challenges on global challenges 81 organisations working 2.4.2 A review of Figure 11: Number of academic papers on various topics (listed in Scopus, August 2012) From the paper “Existential Risk Prevention as Global Priority” 79 52 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 2.4 Methodology Climate Change Nuclear War Pandemic Resource Depletion Biological Weapons Computer Failure Government Failure Nanotech Chemical Weapons Artificial Intelligence Genetic Engineering System Failure Biodiversity loss Ecological Failure Poverty Volcano Asteroid / Comet / Meteor Astronomic Explosion Biogeochem Chemical Pollution Extraterrestrial High Energy Physics New Technology Ozone Depletion Atmospheric Aerosols Dysgenics EM Pulse Interstellar Cloud LULCC Ocean Acidification Phase Transition Reject Procreation Simulation Unknown 13 13 12 9 8 7 7 7 6 5 4 4 2 2 2 2 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 4 8 12 2 6 10 14 be able to adjust their focus according to which challenges they consider the most important. The organisation coding used the same coding scheme developed for coding survey publications. References to specific global challenges were obtained from organisations’ websites. Many have web pages which list the topics they work on. Where possible, references to global challenges were pulled from these pages. Additional references to these challenges were identified by browsing other web pages, including recent publications. While it is possible that some of these organisations have worked on global challenges not mentioned on the web pages that were examined, overall the main challenges that they have worked on have probably been identified and coded. So the results should give a reasonably accurate picture of what global challenges these organisations are working on. Organisations working with global challenges were initially selected on the basis of the literature overview. A snowball sampling was conducted based on the list of organisations identified, according to whether they claimed to work on global challenges and/or their web page contained information about “existential risk”, “global catastrophic risk”,“human extinction” or “greatest global challenges”. Cross-references between organisations and input during the workshops were also used to identify organisations. An initial list of 180 organisations which work with global challenges was established. Based on the production of relevant literature, which other organisations referred to the organisation, and/or are seen as influential by groups interviewed during the process, a short-list of organisations were selected for a closer examination regarding the challenges they work with. Then those working with multiple challenges were selected, resulting in a list of 19 organisations.83 Below is the overview of the results from the overview of key organisations working with multiple global challenges. The organisations working on global challenges vary widely in: 1. What they count as a global challenge 2. How systematically they identify global challenges; and 3. Their emphasis on the most important global challenges For most organisations working with global challenges there are no explanations for the methodology used to select the challenges. Only a few thought leaders, like Tower Watson and their Extreme Risk Report 2013, have a framework for the challenges and estimates of possible impacts. Figure 12: Global challenges that key organisations work with Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 53 2.4 Methodology Climate Change Nuclear War Pandemic Resource Depletion Biological Weapons Computer Failure Government Failure Nanotech Chemical Weapons Artificial Intelligence Genetic Engeneering System Failure Atmospheric Aerosols 13 13 12 9 8 7 7 7 6 5 4 4 0 4 8 12 2 6 10 14 In most cases there is neither a definition of the impact, nor a definition of the probability. The report that focuses on global risk which is probably best known is the WEF Global Risk Report. The WEF’s risk work, with many other groups’, is probably best described as belonging to the category of risk perception rather than risk assessment, where experts are asked to estimate risks, but without any clear definition of probability or impact. The more serious organisations, like the WEF, also clearly define what they do as discussing perception of risk, not a scientific assessment of the actual risk. The WEF describes its perception methodology as follows: “This approach can highlight areas that are of most concern to different stakeholders, and potentially galvanise shared efforts to address them.” 85 The question which people are asked to answer is: “What occurrence causes significant negative impact for several countries and industries?” 86 The respondents are then asked to provide a number on two scales from 1-4, one for impact and another for likelihood (within 10 years).87 It is then up to the respondent to define what 1-4 means, so the major value of the report is to track the changes in perception over the years. Such perception approaches are obviously very interesting and, as the WEF states, can influence actual probability as the readers’ decisions will be influenced by how different challenges are perceived. Still, it is important to remember that the report does not provide an assessment of the actual probability (0-100%) or an assessment of the impact (and not the impact on human suffering, as many respondents likely define risk in monetary terms for their own company or country). An overview of WEF reports from the last ten years indicates that the challenges that likely could happen when applying a five year horizon, like the first signs of climate change, governmental failure and traditional pandemic, are identified. On the other hand, challenges which have very big impacts but lower probability, like extreme climate change, nanotechnology, major volcanoes, AI, and asteroids, tend to get less, or no, attention. An important question to explore is whether a focus on the smaller but still serious impacts of global challenges can result in an increased probability of infinite impacts. For example, there are reasons to believe that a focus on incremental adaptation instead of significant mitigation could be a problem for climate change as it could result in high-carbon lock-in.88 Other research indicates that focus on commercially relevant smaller pandemics could result in actions that make a major pandemic more likely. It is argued that this could happen, for example, by encouraging increased trade of goods while investing in equipment that scans for the type of pandemics that are known. Such a system can reduce the probability for known pandemics while at the same time resulting in an increased probability for new and more serious pandemics.89 Figure 13: The top 12 global challenges that key organisations work with 2.4.3 Workshops global risks 2.5 The list of Two workshops were arranged where the selection of challenges was discussed, one with risk experts in Oxford at the Future of Humanity Institute and the other in London with experts from the financial sector. See Appendix 2 for agenda and participants. In both workshops the list of global challenges was discussed to see if any additional challenges should be included, or if there were reasons to exclude some from the list. No challenge was excluded at the workshops, but one was added. Although little research exists yet that is able to verify the potential impacts, the participants agreed to include Global System Collapse as a risk with possible infinite impact. There was agreement that further research is needed to clarify exactly what parts of the economic and political system could collapse and result in a potentially infinite outcome. The conclusion was that enough research exists to include such a collapse on the list. Based on the risks identified in the literature review and in the review of organisations and applying the criteria for potentially infinite impact, these risks were identified: 1. Extreme Climate Change 2. Nuclear War 3. Global Pandemic 4. Ecological Catastrophe 5. Global System Collapse 6. Major Asteroid Impact 7. Supervolcano 8. Synthetic Biology 9. Nanotechnology 10. Artificial Intelligence (AI) 11. Unknown Consequences 12. Future Bad Global Governance This is an initial list. Additional risks will be added as new scientific studies become available, and some will be removed if steps are taken to reduce their probability90 and/or impact so that they no longer meet the criteria. Four categories of global challenges The challenges included in this report belong to four categories. The first, current challenges, includes those where decisions today can result directly in infinite impacts. They are included even if the time between action and impact might be decades, as with climate change. The second category is exogenous challenges, those where decisions do not – currently – influence probability, but can influence impact. The third category is emerging challenges, those where technology and science are not advanced enough to pose a severe threat today, but where the challenges will probably soon be able to have an infinite impact. The technologies included in emerging challenges, including synthetic biology, nanotechnology and artificial intelligence (AI), will be critical to finding solutions to infinite impacts. Including these technologies should not be seen as an attempt to arrest them. If anything, the development of sustainable solutions should be accelerated. But it is equally important to create guidelines and frameworks to avoid their misuse, whether intentional or accidental. The fourth category, future global policy challenges, is of a different kind. It includes challenges related to the consequences of an inferior or destructive global governance system. This is especially important as well-intended actions to reduce global challenges could lead to future global governance systems with destructive impact. The first category, current challenges, includes: 1. Extreme Climate Change 2. Nuclear War 3. Global Pandemic 4. Ecological Catastrophe 5. Global System Collapse The second category, exogenous challenges, covers: 6. Major Asteroid Impact 7. Supervolcano Those in the third category, emerging challenges, are: 8. Synthetic Biology 9. Nanotechnology 10. Artificial Intelligence (AI) 11. Unknown Consequences The fourth category, global policy challenges, is: 12. Future Bad Global Governance not included 2.5.1 Risks Many risks could severely damage humanity but have not been included in this report. They were excluded for one or more of three reasons: 1. Limited impact. Many challenges can have significant local negative effects, without approaching the “2 billion negatively affected” criterion - tsunamis, for example, and chemical pollution. 2. No effective countermeasures. The report focuses on promoting effective interventions and so ignores challenges where nothing useful can be done to prevent or mitigate the impact, as with nearby gamma-ray bursts. 3. Included in other challenges. Many challenges are already covered by others, or have a damage profile so similar that there seemed no need to have a separate category. Population growth, for one, is an underlying driver significant for climate change and eco-system catastrophe, but without direct large-scale impacts. The challenges mentioned in the reviewed literature and organisations which are not included in this report often refer to economic damage such as “fiscal crises” or “unemployment”. While such impacts could have far-reaching consequences they are obviously of another magnitude than those included here. Some of the risks that were suggested and/or which exist in books and reports about global risks were rejected according to the criteria above. They include: 91 1. Astronomical explosion/nearby gamma-ray burst or supernova.92 These seem to be events of extremely low probability and which are unlikely to be survivable. Milder versions of them (where the source is sufficiently far away) may be considered in a subsequent report. ͢ Not included due to: No effective countermeasures 2. False vacuum collapse. If our universe is in a false vacuum and it collapses at any point, the collapse would expand at the speed of light destroying all organised structures in the universe.93 This would not be survivable. ͢ Not included due to: No effective countermeasures 3. Chemical pollution. Increasingly, there is particular concern about three types of chemicals: those that persist in the environment and accumulate in the bodies of wildlife and people, endocrine disruptors that can interfere with hormones, and chemicals that cause cancer or damage DNA. ͢ Not included due to: Limited impact 4. Dangerous physics experiments creating black holes/strangelets including high energy physics. These risks are of low probability94 and have been subsumed under “Uncertain Risks”. ͢ Not included due to: Included in other challenges 5. Destructive solar flares. Though solar flares or coronal mass ejections could cause great economic damage to our technological civilisation,95 they would not lead directly to mass casualties unless the system lacks basic resilience. They have been subsumed in the Global System Collapse category. ͢ Not included due to: Limited impact/included in other challenges 6. Moral collapse of humanity. Humanity may develop along a path that we would currently find morally repellent. The consequences of this are not clear-cut, and depend on value judgements that would be contentious and unshared.96 Some of these risks (such as global totalitarianism or enduring poverty) were included in the Governance Disasters category. ͢ Not included due to: included in other challenges 7. Resource depletion/LULCC/ Biodiversity loss. It has often been argued that declining resources will cause increased conflict.97 Nevertheless such conflicts would not be sufficient in themselves to threaten humanity on a large scale, without a “ System Collapse” or “Governance Disasters”. ͢ Not included due to: included in other challenges 8. New technological experimental risks. It is possible and plausible that new unexpected technological risks will emerge due to experiments. However, until we know what such risks may be, they are subsumed in the “Uncertain Risks” category. ͢ Not included due to: included in other challenges 9. Genocides. Though immense tragedies within specific areas, past genocides have remained contained in space and time and haven’t spread across the globe.98 ͢ Not included due to: Limited impact 10. Natural disasters. Most natural disasters, like tsunamis and hurricanes, have no likelihood of causing the extent of casualties100 needed for consideration on this list, as they are geographically limited and follow relatively mild impact probability curves. ͢ Not included due to: Limited impact 11. Computer failure/Cyberwarfare. Though an area of great interest and research, cyberwarfare has never caused mass casualties and would be unlikely to do so directly. It may be the subject of a future report, but in this report it is considered to be a subset of warfare and general destabilising risks. ͢ Not included due to: Limited impact/Submersed in other challenges 12. Underlying trends, e.g. overpopulation. Though increased population will put strains on resources and can contribute to increased probability for other challenges included in this report (such as climate change and ecosystem catastrophe), plausible population levels will not cause any direct harm to humanity.101 Population growth is however an important trend that is significantly affecting several risks. ͢ Not included due to: Limited impact/Submersed in other challenges Note: Important underlying trends are discussed in chapter 5. 2.5 The rseulting list of global risks using this methodology the infinite threshold impact levels beyond 2.6 Relationship between General mitigation and resilience Total short term casualties Civilisation collapse General pre-risk collapse countermeasures Post-risk collapse countermeasures Post-collapse external threats and risks Post-collapse politics Maintaining technology base Long-term reconstruction probability Anthropic effect Extinction Pre-risk rebuilding enablers (tech stores...) Social and ecosystem resilience Long term impact Post-risk politics Complex systems are often stable only within certain boundaries. Outside these boundaries the system can collapse and rapidly change to a new stable state, or it can trigger a process where change continues for a long time until a new stable state is found. Sometimes it can take a very long time for a system to stabilise again. Looking at all the biotic crises over the past 530 million years, a research team from Berkeley found an average of 10 million years between an extinction and a subsequent flourishing of life.102 What makes things difficult is that once a system is unstable, a small disaster can have knock-on effects – the death of one Austrian nobleman can result in an ultimatum which draws in neighbours until Australians end up fighting Turks and the First World War is well under way, to be followed by communism, the Second World War and the Cold War. The challenge of understanding complex systems includes the fact that many of them have multiple attractors, including what are called “strange attractors”.103 Changes are close to linear as long as the system does not change very much, but once it is pushed out of balance it will get closer to other attractors, and when those become strong enough the system will tend to move towards chaos until a new balance is achieved around the new attractor.104 None of the risks in this report is likely to result directly in an infinite impact, and some cannot do so physically. All the risks however are big enough to reach a threshold where the social and ecological systems become so unstable that an infinite impact could ensue, as the graph below shows. This graph and its accompanying text explain, how an event that reaches a threshold level could cascade into even worse situations, via civilisation collapse105 to human extinction. The graph also seeks to illustrate the importance of ensuring ecological and social resilience, the two major insurance policies we have against a negative spiral after a major impact that takes us beyond the infinite threshold. 2.6 Relations between impact levels beyond the infinite threshold 1. Social and ecosystem resilience. Resilient systems are naturally resistant to collapse, though this often comes at the cost of efficiency.106 The more resilient the system, the more likely it is to be able to adapt to even large disasters. Improving resilience ahead of time can improve outcomes, even if the nature of the disaster isn’t known. 2. General pre-risk collapse countermeasures. This category consists of all those measures put into place ahead of time to prevent civilisation collapse. It could include, for instance, measures to ensure continuity of government or prevent breakup of countries (or to allow these breakups to happen with the minimum of disruption). At the same time it should be noted that these kinds of measures could also trigger the breakdown. 3. General mitigation and resilience. This category consists of all measures that can reduce the impact of risks and prevent them getting out of hand (excluding social and ecosystem measures, which are important and general enough to deserve their own category). 4. Pre-risk rebuilding enablers. On top of attempting to prevent collapses, measures can also be taken to enable rebuilding after a collapse.107 This could involve building stores of food, of technology, or crucial reconstruction tools.108 Alternatively, it could involve training of key individuals or institutions (such as the crews of nuclear submarines) to give them useful post-collapse skills. 5. Long-term impact. Some risks (such as climate change) have strong long-term impacts after years or even decades. Others (such as pandemics) are more likely to have only a short-term impact. This category includes only direct longterm impacts. 6. Post-risk politics. The political structures of the post-risk world (governmental systems, conflicts between and within political groupings, economic and political links between groups) will be important in determining if a large impact leads ultimately to civilisation collapse or if recovery is possible. 7. Post-risk collapse countermeasures. These are the countermeasures that the postrisk political structures are likely to implement to prevent a complete civilisation collapse. 8. Maintaining a technology base. Current society is complex, with part of the world’s excess production diverted into maintaining a population of scientists, engineers and other experts, capable of preserving knowledge of technological innovations and developing new ones. In the simpler post-collapse societies, with possibly much lower populations, it will be a challenge to maintain current technology and prevent crucial skills from being lost.109 9. Post-collapse politics. Just as post-risk politics are important for preventing a collapse, post-collapse politics will be important in allowing a recovery. The ultimate fate of humanity may be tied up with the preservation of such concepts as human rights, the scientific method and technological progress. 10. Post-collapse external threats and risks. Simply because a risk has triggered the collapse of human civilisation, that does not mean that other risks are no longer present. Humanity will have much less resilience to deal with further damage, so the probability of these risks is important to determine the ultimate fate of humanity. 11. Anthropic effects. We cannot observe a world incapable of supporting life, because we could not be alive to observe it. When estimating the likelihood of disasters and recovery it is very important to take this effect into consideration and to adjust probability estimates accordingly.110 12. Long-term reconstruction probability. A post-collapse world will differ significantly from a preindustrial revolution world. Easy access to coal and oil will no longer be possible. In contrast, much usable aluminium will have been extracted and processed and will be left lying on the surface for easy use. Thus it will be important to establish how technically possible it may be to have a second industrial revolution and further reconstruction up to current capabilities without creating the problems that the first industrial revolution resulted in. “You may choose to look the other way but you can never say again that you did not know.” William Wilberforce Challenges 3. Twelve Global 60 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3. Twelve Global Challenges Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences For the selection of events information from specialised bodies and scientific journals in the area of global risk was gathered.111 Using keywords related to the various risks, a global selection of events was sought, along with original sourcing in academic or official sources. The list of events was then ranked based on their risk relevance, i.e. their effect on the probability and/or the impact of the challenge. To finalise the list, a group of experts was consulted by email and a draft overview of the challenges was presented at a workshop at the Future of Humanity Institute (FHI) in Oxford, where additional input was provided on selection and content. Issue experts were then consulted before the final list of events was established. 112 Four categories were used to classify the different events: 1. Policy: Global or national policy initiatives that affect probability and/or impact 2. Event: The challenge is made real in some way that is relevant for probability and/or impact 3. Research: New knowledge about probability and/or impact 4. Initiative: A stakeholder/group addressing the challenge in concrete ways to reduce probability and impact Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 61 3. Twelve Global Challengesof risks Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences 3.1Current risks Climate Change 3.1.1 Extreme Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions (i.e., more or fewer extreme weather events). Extreme climate change is used to distinguish from the impacts beyond the dangerous climate that a 2° C temperature rise is expected to result in.113 62 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 3.1.1.1 Expected impact disaggregation 3.1.1.2 Probability Many of the expected impacts of climate change are well known, including a warming climate, more severe storms and droughts, rising sea levels, ocean acidification, and damage to vulnerable ecosystems.114 As for all risks there are uncertainties in the estimates, and warming could be much more extreme than the middle estimates suggest. Models tend to underestimate uncertainty115 (especially where impact on humanity is concerned,116 where the effect also depends on modellers’ choices such as the discount rate117), so there is a probability118 that humanity could be looking at a 4°C119 or even 6°C120 warming in the coming decades. This could arise from positive feedback loops, such as the release of methane from permafrost121 or the dieback of the Amazon rainforests,122 that strengthen the warming effect. So far, efforts at curbing emissions have been only moderately successful and are still very far from what is needed.123 The impact of global warming, whether mild or severe, would be felt most strongly in poorer countries. Adaptation that can address significant warming is often very expensive,124 and many of the poorest countries are in the tropics and sub-tropics that would be hardest hit (they could become completely uninhabitable for the highest range of warming125). Mass deaths and famines, social collapse and mass migration are certainly possible in this scenario. Combined with shocks to the agriculture and biosphere-dependent industries of the more developed countries, this could lead to global conflict and possibly civilisation collapse – to the extent that many experts see climate change as a national security risk126. Further evidence of the risk comes from indications that past civilisation collapses have been driven by climate change.127 Extinction risk could develop from this if the remaining human groups were vulnerable to other shocks, such as pandemics, possibly exacerbated by the changed climate.128 There is some evidence of 6°C climate change causing mass extinction in the past,129 but a technological species such as ourselves might be more resilient to such a shock. A unique feature of the climate change challenge is what is called geo-engineering.130 Though this could - if it works - reduce many impacts at a relatively low cost, it would not do so evenly. Geo-engineering would possibly reduce the impacts of climate change in some countries, benefitting them while leaving others to suffer.131 This could lead to greater political instability. One of the most popular geo-engineering ideas – stratospheric sulphate aerosols – suffers from the weakness that it must be continuous. 132 If for any reason it stopped (such as a civilisation collapse), warming would resume at a significantly higher pace, reaching the point where it would have been without geo-engineering. The speed of this rebound would put extra pressure on the ecosystem and the world’s political system. So the biggest challenge is that geoengineering may backfire and simply make matters worse.134 Five important factors in estimating the probabilities and impacts of the challenge: 1. The uncertainties in climate sensitivity models, including the tail. 2. The likelihood - or not - of global coordination on controlling emissions. 3. The future uptake of low-carbon economies, including energy, mobility and food systems. 4. Whether technological innovations will improve or worsen the situation, and by how much. 5. The long-term climate impact caused by global warming. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 63 3.1 Current risks CLIMATE CHANGE Climate research Pre-warming mitigation efforts Pre-warming collapse countermeasures Climate warfare Collapse of geoengineering projects New, polluting, uses for carbon products Low-carbon economies Geoengineering Technological innovations Research in emmision-reducing technologies Global coordination Economic transformations Research in mitigation and adaptation Moderate climate change Global poverty Extreme climate change Feedback loops Carbon emissions Climate change mitigation and adaptation Direct casualties Political instability in vulnerable nations Agriculture disruption Disruption to world politics and economy Ecosystem damage (e.g. ocean acidification) Post warming politics Long-term climate effects Forced migration Total short-term casualties Meta-uncertainty on how to predict the international political process Meta-uncertainty on the true uncertainty in climate change models Increased storms, flooding and natural disaters Civilization collapse Easily visible effects of climate change Extinction Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts GOVERNANCE DISASTERS Global povety Global instability New system of governance Smart sensors Global coordination Improvements to global governance Deliberate attempts to construct world dictatorship Technological innovations Enduring poverty Not achieving important ethical goals Climate change Lack of human flourishing Undesirable world system (e.g. global dictatorship) Global pollution Disruption to world politics and economy Total short-term casualties Collapse of world system Post-disaster politics General mitigation effort Long-term negative effects Civilisation collapse Extinction Failing to solve important problems Making things worse Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts Meta-uncertainty on tradeoffs between e.g. poverty, survival, freedom 64 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 1. Research which further refines our understanding of climate change and geo-engineering ideas will be essential in predicting change, preparing for it, and potentially reversing it. On the negative side, climate science research may allow the possibility of climate change tools being used for warfare. 2. Global poverty will affect both the vulnerability of many nations to the effects of climate change, and the likelihood of achieving global coordination earlier rather than later. 3. Pre-extreme warming mitigation efforts will affect the level of impact from climate change. 4. Pre-warming collapse countermeasures will affect the likelihood of civilisation collapse. 5. Research into mitigation and adaptation is necessary for effective implementation of either approach. 6. Research into emission-reducing technologies (such as alternative energies) will be important for transitioning to a low carbon economy. 7. Global coordination and cooperation will be key to funding mitigation/ adaptation research and development, and for the global control of carbon emissions or transitioning to a global low carbon economy. 8. Climate warfare is possible if geoengineering and climate modification methods can be harnessed by nations to harm others. 9. New, more polluting uses of carbon would, if they had a strong economic rationale, put upwards pressure on carbon emissions. 10. The direct casualties of limited global warming are likely to be few, as humans can adapt to many different temperatures and climates. The indirect effect can however be significant, e.g. migration, starvation, extreme weather. 11. Climate change is likely to cause extensive ecosystem damage, such as ocean acidification and pressure on many sensitive species that cannot easily adapt to temperature changes. 12. Agriculture will be disrupted by increased temperature. 13. The direct and indirect effects of climate change will have a great impact on the world’s political and economic systems, which will in turn determine the severity of the changes. 14. Many nations will be made politically vulnerable to the direct and indirect impacts of climate change, putting great pressure on their political systems and institutions. 15. Climate change will cause an increase in storms, floods, and other natural disasters. If political stability is maintained, most of the casualties are likely to result from these factors. 16. Forced migration from unstable or disrupted areas will put further pressure on more stable areas. 17. The long-term impact of climate change (including further carbon emissions and warming) will be important for determining the risk of collapse and subsequent rebuilding possibilities. 18. Attempts to mitigate and adapt to climate change will be important for reducing the severity of climate change’s impact. 19. The level of carbon emissions is the driver of climate change, and will be crucial in determining its ultimate impact. 20. Feedback loops will be important in determining whether carbon emissions are self-damping or self-forcing (i.e. whether an extra ton of CO2 emissions is likely to result in more or less than a ton in the atmosphere). 21. Transitioning to low carbon economies will be crucial for reducing emissions without disrupting the world’s political or economic systems. 22. Geo-engineering offers the possibility of decreasing carbon concentration in the atmosphere alongside, or instead of, emission reductions. But it may make climate warfare a possibility. 23. If geo-engineering projects collapse in the middle of implementation, this could lead to strong warming over a dangerously short period of time. 24. Technological innovations will be crucial for transitioning to low carbon economies or allowing geo-engineering. But they may also result in new, carbon-intensive innovations, which, if sufficiently profitable, could push emissions up. 25. Some level of changes to the standard economic system may be needed to transition to low carbon economies. 26. Easily visible impacts of climate change may be instrumental in pushing better global coordination on the issue. 27. The political systems in place as warming increases will determine how well the world copes with a hotter planet. 28. Climate models are extremely detailed and inevitably uncertain. But the real level of uncertainty includes uncertainties about the models themselves. 29. The course of international politics is extremely hard to predict, even for political scientists.135 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 65 3.1 Current risks during 2013 3.1.1.3 Main events 19-Apr-13: Launch of the report “Unburnable Carbon 2013: Wasted capital and stranded assets” 136 – Research To constrain the rise in global average temperature to less than 2°C above pre-industrial levels, a maximum of around 565 – 886 billion tonnes (Gt) of carbon dioxide could be emitted before 2050.137 The world’s proven fossil fuel reserves amount to 2,860 Gt of CO2, however, and are viewed as assets by companies and countries. Since it is likely that these assets cannot be realised, these entities are over-valued at current prices – arguably, a “carbon bubble.” The report provides evidence that serious risks are growing for highcarbon assets, and aims to help investors and regulators manage these risks more effectively and prepare for a global agreement on emissions reductions. It indirectly highlights part of the challenge of emissions reductions: they will mean the loss of highly valuable assets to corporations and governments. 02-May-13: CO2 at 400 PPM for the first time in > 800,000 years138 – Event The Mauna Loa carbon dioxide record, also known as the “Keeling Curve,” is the world’s longest unbroken record of atmospheric CO2 concentrations. It recently reached 400 ppm (parts per million) of CO2. Such concentrations have not been reached for at least 800,000 years,139 placing humanity in a historically unprecedented situation. Prior to the Industrial Revolution, natural climate variations caused atmospheric CO2 to vary between about 200 ppm during ice ages and 300 ppm during the warmer inter-glacial periods. The last time concentrations were as high as they are now seems to have been during the Mid-Pliocene, about 3 million years before the present when temperatures were 2-3°C warmer, and in which geological evidence and isotopes agree that sea level was at least 15 to 25 m above today’s levels with correspondingly smaller ice sheets and lower continental aridity.140 21-May-13: China agrees to impose carbon targets by 2016141 – Policy Since China is the world’s greatest emitter of CO2,142 any reduction steps it takes can have a substantial impact. It has announced a “National Low Carbon Day“,143 a “series of major promotional events to improve awareness and get the whole society to address climate change.” More practically, the Chinese government has agreed to impose carbon targets by 2016 - a ceiling on greenhouse gas emissions.144 Figure 14-15, Source: Scripps Institution of Oceanography, via http://blogs.scientificamerican.com/ observations/2013/05/09/400-ppm-carbon-dioxide-in-the-atmosphere-reaches-prehistoric-levels 66 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 22-May-13: Private Sector Initiative - database of actions on adaptation145 – Initiative Global warming is an externality146 – a consequence of business decisions made by entities that do not bear the full cost of what they decide – so the drive to mitigate its effects is more likely to come from governmental or supra-governmental organisations. Nevertheless, the private sector has been involved in mitigation attempts for a variety of reasons, from investment opportunities to public relations. The United Nations Framework Convention on Climate Change (UNFCCC) maintains a database of some of these attempts, ranging from Ericsson’s enabling access to climate services in Uganda, through BASF’s development of new technologies for food security, Allianz insurers rewarding sustainable business practices, all the way to Chiles de Nicaragua’s attempts to enable small agro-exporters to adapt to climate change – and many more. The potential opportunities for private companies are listed as: – New market opportunities and expansion; – Development of climate-friendly goods and services; – Potential cost savings; – Risk reduction measures, including physical operations; – Climate proofing the supply chain; – Enhanced corporate social responsibility. 27-Sep-13: IPCC report: “Climate Change 2013: The Physical Science Basis” 147 – Research The 5th IPCC report “considers new evidence of climate change based on many independent scientific analyses from observations of the climate system, palaeoclimate archives, theoretical studies of climate processes and simulations using climate models.” It concludes that: – Warming of the climate system is unequivocal, and since the 1950s many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased. – Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. – Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850. – Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent. – The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (high confidence). Over the period 1901 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m. – The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. Carbon dioxide concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The report further predicted, amongst other points, that: – Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions. – The oceans will continue to warm during the 21st century. Heat will penetrate from the surface to the deep ocean and affect ocean circulation. Further uptake of carbon by the oceans will increase ocean acidification. Global mean sea level will continue to rise during the 21st century. – It is very likely that Arctic sea ice cover will continue to shrink and become thinner. Global glacier volume will further decrease. – Most aspects of climate change will persist for many centuries even if emissions of CO2 are stopped. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 67 3.1 Current risks 27-Sep-13: Launch of the Global Risk and Opportunity Indicator (GROI) 148 – Research Launched by the Global Challenge Foundation, this Indicator is a web tool for illustrating quantified risks, with the objective of increasing awareness about global risks and opportunities and helping guide the changes required in the global governance system. The site is still under construction; the Foundation’s aims are to achieve, by the end of 2014: 1. An interactive Global Risk & Opportunity Indicator that allows users to calculate the probability for any global warming, between one and ten degrees Celsius, at different greenhouse gas concentrations. The indicator will then be further developed to illustrate interdependencies with other global risks and highlight opportunities for minimising the risks. Subsequent development will allow users to change different underlying assumptions and see the corresponding change in risk. 2. Methodology and data to estimate probabilities for a number of climate impacts at different temperature levels, e.g., sea level rise, droughts, flooding and heat waves, as well as to explore the risk of runaway global warming. 3. Methodology and data to estimate the probability of existential climate threats, i.e., to estimate the risk that climate change impacts pose a significant threat to human civilisation – defined as a serious negative impact on at least two billion people. 23-Nov-13: Limited progress at Warsaw COP 19 climate negotiations 149 – Policy The global environment can be considered a global public good (i.e. non-excludable and non-rivalrous).150 Economic theory claims that such goods will be undersupplied by the market.151 Hence the importance of trans-national negotiations to address climate change. Despite the importance of the subject, the main achievement of the Warsaw negotiations was to keep talks on track for more negotiations in 2015.152 Though there was general agreement on the necessity of cutting carbon emissions, the dispute was over how to share the burden of doing so. In this instance, the debate was between more- and less-developed countries, with the latter demanding compensation from the former to help them cope with the burden of reducing emissions. That particular dispute was papered over,153 but similar ones will be likely in future due to the range of different actors and their divergent agendas.154 03-Dec-13 Abrupt Impacts of Climate Change: Anticipating Surprises155 – Research Climate change has been developing gradually, at least on the human scale156 (though very rapidly on a geological timescale157). This may not continue, however: this paper looks at the potential for abrupt changes in physical, biological, and human systems, in response to steady climate change. It highlights two abrupt changes that are already under way: the rapid decline in sea ice158 and the extinction pressure on species.159 On the other hand, some widely discussed abrupt changes – the rapid shutdown of the Atlantic Meridional Overturning Circulation160 and the rapid release of methane from either thawing permafrost161 or methane hydrates162 – are shown to be unlikely to occur this century. The report argues that large uncertainties about the likelihood of some potential abrupt changes163 highlight the need for expanded research and monitoring, and propose an abrupt change early warning system. The aim would be to foresee abrupt change before it occurs, and reduce the potential consequences. 68 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 69 3.1 Current risks Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences 3.1 Current risks 3.1.2 Nuclear War After their use in Hiroshima and Nagasaki nuclear weapons have never been used in a conflict, but because they are extremely powerful and could cause destruction throughout the world, the possibility of nuclear war has had a great effect on international politics. 164 70 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 3.1.2.1 Expected impact disaggregation 3.1.2.2 Probability The likelihood of a full-scale nuclear war between the USA and Russia has probably decreased in recent decades due to some improvements in relations between these two countries and reductions in the size of their arsenals. Still, the potential for deliberate or accidental165 nuclear conflict has not been removed, with some estimates putting the risk of nuclear war in the next century or so at around 10%166 – it may have been mostly down to luck that such a war did not happen in the last half century167. A nuclear war could have a range of different impacts. At the lowest end is the most obvious and immediate impact: destruction and death in major cities across the world, due to the explosions themselves and the radioactive fallout. But even if the entire populations of Europe, Russia and the USA were directly wiped out in a nuclear war – an outcome that some studies have shown to be physically impossible168, given population dispersal and the number of missiles in existence169 – that would not raise the war to the first level of impact, which requires > 2 billion affected.170 A larger impact would depend on whether or not the war triggered what is often called a nuclear winter or something similar.171 The term refers to the creation of a pall of smoke high in the stratosphere that would plunge temperatures below freezing around the globe and possibly also destroy most of the ozone layer.172 The detonations would need to start firestorms in the targeted cities, which could lift the soot up into the stratosphere.173 There are some uncertainties about both the climate models and the likelihood of devastating firestorms,174 but the risks are severe and recent models175 have confirmed the earlier176 analysis. Even a smaller nuclear conflict (between India and Pakistan, for instance) could trigger a smaller nuclear winter which would place billions in danger.177 The disintegration of the global food supply would make mass starvation and state collapse likely. As the world balance of power would be dramatically shifted and previous ideological positions called into question, large-scale war would be likely. This could lead to a civilisation collapse. Extinction risk is only possible if the aftermath of the nuclear war fragments and diminishes human society to the point where recovery becomes impossible178 before humanity succumbs179 to other risks, such as pandemics.180 Five important factors in estimating the probabilities and impacts of the challenge: 1. How relations between current and future nuclear powers develop. 2. The probability of accidental war. 3. Whether disarmament efforts will succeed in reducing the number of nuclear warheads. 4. The likelihood of a nuclear winter. 5. The long-term effects of a nuclear war on climate, infrastructure and technology. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 71 3.1 Current risks NUCLEAR WAR US-Russia relations Relations between future major nuclear powers Number of future major nuclear powers Meta-certainty of changes in the military technology Meta-certainty of political predictions Disarmament efforts Proliferation: desire for nuclear weapons Proliferation: building nuclear weapons Number of future small nuclear powers Relations between future nuclear powers Relations between current nuclear powers Nuclear attack Nuclear attack Full-scale Nuclear War Disruption to world politics and economy War casualties Firestorm risks Firestorm risks Nuclear Winter Small Nuclear Winter Post-war politics Pre-war casualty countermeasures (bunkers, food...) Long-term impact Extinction Civisation collapse Total short term casualties War casualties Nuclear accidents or misunderstandings Small-scale Nuclear War Nuclear terrorism Nuclear security Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts GOVERNANCE DISASTERS Global povety Global instability New system of governance Smart sensors Global coordination Improvements to global governance Deliberate attempts to construct world dictatorship Technological innovations Enduring poverty Not achieving important ethical goals Climate change Lack of human flourishing Undesirable world system (e.g. global dictatorship) Global pollution Disruption to world politics and economy Total short-term casualties Collapse of world system Post-disaster politics General mitigation effort Long-term negative effects Civilisation collapse Extinction Failing to solve important problems Making things worse Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts Meta-uncertainty on tradeoffs between e.g. poverty, survival, freedom 72 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 1. The success or failure of disarmament will determine the number of nuclear warheads available for a future nuclear conflict. 2. The first step of proliferation is countries desiring to possess nuclear weapons. Various political interventions may reduce or increase this desire. 3. The second step of proliferation is countries building nuclear weapons. Various mechanisms, agreements and inspections may be relevant 4. Nuclear terrorism may be the trigger of a larger nuclear conflict, especially if the detonation is misinterpreted as a traditional attack. 5. The security of nuclear weapons and materials affects both the probability of nuclear terrorism and the control likelihood of nuclear accidents. 6. The relations between future nuclear powers will be the major determinant of whether a nuclear war breaks out. 7. The relations between current nuclear powers will be a major determinant of the relations between future nuclear powers. 8. The relations between future major nuclear powers will be the major component of determining whether a major nuclear war breaks out. 9. Relations between the USA and Russia (the only current major nuclear powers) will be a major determinant of the relations between future major nuclear powers. 10. Pre-war countermeasures (such as nuclear bunkers and food stores) can help mitigate the casualties of a smaller nuclear conflict. 11. A small-scale nuclear war could start with an attack by one or more nuclear powers. 12. A full-scale nuclear war could start with an attack by one or more major nuclear powers. 13. Aside from attacks, the other way a nuclear war could start would be through accidental firings or misinterpretations of other incidents. 14. Firestorms caused by burning cities are one of the main ways a nuclear conflict could cause major climate disruption, and hence high casualties. 15. The direct war casualties from a nuclear conflict are likely to be small compared with the potential climate effects. 16. A nuclear winter is the way in which a nuclear conflict could have the most damaging effects on the world. 17. Even a smaller nuclear conflict could trigger a smaller nuclear winter that could have major disruptive effects on agriculture and hence human survival. 18. Any war will have a disruptive impact on the world’s politics and economy. A nuclear conflict – possibly accompanied by a nuclear winter – even more so. 19. The long term impact of nuclear winter, infrastructure disruption, and possibly radiation, will determine the likelihood of collapse and rebuilding. 20. Since a nuclear power must be one of the parties to a nuclear war, the number of the former affects the probability of the latter. 21. Since a major nuclear power must be one of the parties to a major nuclear war, the number of the former affects the probability of the latter. 22. Post-war politics will be determined by the war, the disruption it caused, and the number of casualties it inflicted. 23. Unlike other risks, nuclear weapons are targeted by humans, so may take out important parts of the world’s infrastructure (and conventional weapons used in a conflict may have the same effect). 24. Unlike other risks, nuclear weapons are targeted by humans, so may take out important parts of the world’s technology and research base (and conventional weapons used in a conflict may have the same effect). 25. Maintaining a technology base will be complicated by the possible targeting of infrastructure and the technology base during a conflict. 26. The further development of military technology is hard to predict. The current balance of power under MAD (mutually assured destruction) is based on certain assumptions about the effectiveness of nuclear weapons, such as second strike capability. If this were removed (such as by effective submarine detection, or anti-ballistic missile shields), the effect on the balance of power is hard to predict. 27. The course of international politics is extremely hard to predict, even for political scientists.181 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 73 3.1 Current risks during 2013 3.1.2.3 Main events 12-Feb-13: North Korea carries out third, largest nuclear test 182 – Event On 12 February 2013, North Korea carried out its third nuclear test. The test was condemned across the world, 183 and led to increased sanctions184 against the already isolated nation.185 North Korea is the only nation to have withdrawn from the Nuclear NonProliferation Treaty,186 and is the only country to have conducted nuclear tests in the 21st century, starting in 2006, 187 as well as developing a ballistic missile capability.188 It has also been involved in the export of weapons technology, undermining the Treaty.189 Diplomatic attempts to deal with North Korea (especially on the part of the United States) have generally been inconsistent and unsuccessful.190 Though the situation remains a potential flashpoint for conventional and nuclear conflict, and its collapse could have disastrous consequences191 (including the possibility of “loose nukes” becoming available to various groups), it should be noted that the “North Korean problem” has existed in one form or another since the end of the Korean War in 1953, without erupting into open conflict.192 04-Mar-13: Conference: Humanitarian Impact of Nuclear Weapons 193 – Policy On 4 and 5 March 2013, the Norwegian Minister of Foreign Affairs, Espen Barth Eide, hosted an international conference on the humanitarian impact of nuclear weapons. The conference heard presentations on the effects of nuclear weapons detonations. Three key points emerged: – It is unlikely that any state or international body could address the immediate humanitarian emergency caused by a nuclear weapon detonation in an adequate manner and provide sufficient assistance to those affected. Moreover, it might not be possible to establish such capacities at all. – The historical experience from the use and testing of nuclear weapons has demonstrated their devastating immediate and long-term effects. While political circumstances have changed, the destructive potential of nuclear weapons remains. – The effects of a nuclear weapon detonation, irrespective of cause, will not be limited by national borders, and will affect states and people to significant degrees, regionally as well as globally. A number of states wished to explore these issues further, and Mexico said it would host a follow-up conference.194Figure 16, Source: Wikimedia Commons, http://en.wikipedia.org/wiki/ File:Worldwide\_nuclear\_testing.svg CC-BY-SA license. Worldwide nuclear testing, 1945-2013 74 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 16-May-13: Revealed: The USSR and US Came Closer to Nuclear War Than Was Thought 195 – Research Documents recently released under a FOIA (US Freedom Of Information Act) request show that the risk of nuclear conflict between the superpowers was higher than realised at the time. The large-scale 1983 NATO nuclear exercises Able Archer 83” spurred “a high level of Soviet military activity, with new deployments of weapons and strike forces.” This unprecedented Soviet reaction in turn created a series of introspective US intelligence analyses and counter-analyses, debating whether US intelligence had actually understood Soviet actions, perceptions, and fears – and acknowledging the danger of nuclear “miscalculation” if it had not.196 This is but one of the many nuclear accidents197 and incidents that peppered the Cold War and its aftermath, and which have been revealed only subsequently. We know now that there were at least three occasions – the Cuban missile crisis in 1962,198 the Petrov incident in 1983199 and the Norwegian rocket incident in 1995200 – where a full-scale nuclear war was only narrowly averted.201 Further information on these incidents, and on how they were interpreted and misinterpreted202 by the great powers, will be important to estimate the probability of nuclear conflict in the coming decades. On a more positive note, efforts are being made to reduce the probability of inadvertent or accidental nuclear conflicts.203 24-Jun-13: Report: “Analysing and Reducing the Risks of Inadvertent Nuclear War Between the United States and Russia” 204 – Research Though the end of the Cold War has reduced the likelihood of deliberate nuclear war, its impact on the risk of accidental nuclear war is much smaller. The arsenals remain on “launch on warning”,205 meaning that there is a possibility for a “retaliatory” strike before an attack is confirmed. The most likely cause of such an accident is either a false warning (of which there have been many, with causes ranging from weather phenomena to a faulty computer chip, wild animal activity, and controlroom training tapes loaded at the wrong time)206 or a misinterpreted terrorist attack.207 The report attempted a rigorous estimate of the numerical probability of nuclear war. Such numerical rigour is rare, with the exception of Hellman’s estimates.208 This report applied risk analysis methods using fault trees and mathematical modelling to assess the relative risks of multiple inadvertent nuclear war scenarios previously identified in the literature. Then it combined the fault tree-based risk models with parameter estimates sourced from the academic literature, characterising uncertainties in the form of probability distributions, with propagation of uncertainties in the fault tree using Monte Carlo simulation methods. Finally, it also performed sensitivity analyses to identify dominant risks under various assumptions. This kind of highly disaggregated analysis is most likely to elicit the best performance and estimates from experts.209 Their conclusion was that (under the more pessimistic assumption), there was a mean 2% risk of accidental nuclear war a year (a high risk when compounded over several decades), with the risk from false alarm being orders of magnitude higher than that from terrorist attacks. The analysis suggests that the most important inadvertent nuclear war risk factor is the short launch decision times,210 inherent in the “launch on warning” posture. Some ways of improving this were suggested, for instance by moving each country’s strategic submarines away from the other’s coasts. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 75 3.1 Current risks 03-Sep-13: Report of the UN General Assembly working group on “Taking Forward Multilateral Nuclear Disarmament Negotiations” 211 – Policy The working group had extensive exchanges of view from different participants, and reviewed existing disarmament commitments and proposals, including international law. The issues surrounding disarmament and treaties were analysed in depth, and several proposals were put forward, with an eye to the complete elimination of nuclear weapons. A key recognition was, however, that “participants recognised the absence of concrete outcomes of multilateral nuclear disarmament negotiations within the United Nations framework for more than a decade”. Indeed, though the Nuclear Non-Proliferation Treaty212 (NPT) is a multilateral treaty closely connected with the United Nations, and though it committed the nuclear powers to reduce their arsenals, all the major nuclear arms reduction deals have been bilateral treaties between the US and the USSR/Russia. These include the INF treaty213, START I214, SORT215, and New START216, which have significantly reduced the world’s stock of nuclear weapons. It has also been argued that the NPT has been undermined by a number of bilateral deals made by NPT signatories, most notably the United States.217 This further serves to emphasise the weakness of international institutions where nuclear arms control is concerned. 15-Nov-13: International Physicians for the Prevention of Nuclear War report: “Nuclear Famine: Two Billion People at Risk?” 218 – Research This report is one of a series of reports and publications in recent years about the potential impacts of nuclear conflicts.219 It looked at the likely consequences of a “limited” nuclear war, such as between India and Pakistan. While previous papers had estimated that up to a billion people might be at risk in such a conflict,220 this report increased the estimate to two billion. The main source of this increase is decreased agricultural production in the United States221 and in China.222 A key component of these estimates was the severe agricultural impact of the relatively mild temperature reduction in 1816, the “year without a summer” 223, due mainly to the “volcanic winter” caused by the eruption of Mount Tambora. The report highlights some significant areas of uncertainty, such as whether a small nuclear conflict and its consequences would lead to further conflicts across the world, and doubts whether markets, governments and other organisations could mitigate the negative impacts. The report is a reminder that even small-scale nuclear conflict could have severe consequences. 24-Nov-13: Nuclear deal with Iran may reduce risk of proliferation 224 – Policy In November, Iran struck a deal with the so called “P5+1” (the five permanent members of the security council, plus Germany). The deal, if it holds, would allow Iran to continue some uranium enrichment, but it would have to submit to inspections to ensure it wasn’t developing a nuclear weapons programme (the deal would also result in eased sanctions in return). There have been longrunning fears than Iran may have been attempting to construct a nuclear weapon225, resulting in sanctions being imposed on it.226 This event illustrates the surprising success of the Non-Proliferation Treaty,227 which came into force in 1970. At the time it was proposed there were fears of very rapid proliferation of nuclear weapons.228 And though 40 countries or more currently have the knowhow to build nuclear weapons,229 only nine countries are currently known to possess them: the five security council members, India, Pakistan, and North Korea, plus Israel.230 76 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 77 3.1 Current risks Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences 3.1 Current risks Catastrophe 3.1.3 Ecological Ecological collapse refers to a situation where an ecosystem suffers a drastic, possibly permanent, reduction in carrying capacity for all organisms, often resulting in mass extinction. Usually an ecological collapse is precipitated by a disastrous event occurring on a short time scale. 231 78 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 3.1.3.1 Expected impact disaggregation 3.1.3.2 Probability Humans are part of the global ecosystem and so fundamentally depend on it for our welfare. Species extinction is proceeding at a greatly increased rate compared with historic data232, and attempts to quantify a safe ecological operating space place humanity well outside it.233 Furthermore, there may be signs of a “sudden” biosphere collapse, possibly within a few generations.234 Many of the problems of ecological degradation interact to multiply the damage and (unlike previous, localised collapses) the whole world is potentially at risk, 235 with severe challenges to countering this risk through global policy.236 If animals are seen to have intrinsic value, 237 or if human quality of life is dependent on a functioning ecosystem, 238 the current situation already represents a large loss. Whether such a loss will extend to human lives depends on technological and political factors - technological, because it seems plausible that some human lifestyles could be sustained in a relatively ecosystem-independent way, at relatively low costs.239 Whether this can be implemented on a large scale in practice, especially during a collapse, will be a political challenge and whether it is something we want is an ethical question. There is currently more than enough food for everyone on the planet to ensure the nutrition needed, 240 but its distribution is extremely uneven and malnutrition persists. Thus ecological collapse need not have a strong absolute effect in order to result in strong localised, or global, effects. Even a partial collapse could lead to wars, mass migrations, and social instability. It is conceivable that such a scenario, if drawn out and exacerbated by poor decision-making, could eventually lead to mass deaths and even the collapse of civilisation. Extinction risk is possible only if the aftermath of collapse fragments and diminishes human society so far that recovery becomes impossible241 before humanity succumbs to other risks (such as climate change or pandemics). After a post-civilisation collapse, human society could still be suffering from the effects of ecological collapse, and depending on what form it took, this could make the recovery of human civilisation more challenging than in some of the other scenarios presented here. Five important factors in estimating the probabilities and impacts of the challenge: 1. The extent to which humans are dependent on the ecosystem. 2. Whether there will be effective political measures taken to protect the ecosystem on a large scale. 3. The likelihood of the emergence of sustainable economies. 4. The positive and negative impacts on the eco systems of both wealth and poverty. 5. The long-term effects of an ecological collapse on ecosystems. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 79 3.1 Current risks ECOLOGICAL CATASTROPHE Long-term ecological effects Post-eco-collapse climate change Moral tragedy from ecosystem loss Quality of life loss from ecosystem loss Ecological collapse Economic costs Disruption to politics and economy Threat to food supply Loss of biodiversity Rebuilding the ecosystem Vulnerabilities to flood and other disasters Sustainable or non-sustainable economies Post-eco-collapse politics Pollution Preservation efforts Pre-eco-collapse climate change New, environmentally damaging industries Meta-uncertainty on the true dependence of humanity on the ecosystem Total short-term casualties Civilisation collapse Extinction Pre-eco-collapse mitigation efforts Human survivability in “closed” systems Global poverty Global coordination Sustainability research Technological innovations Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts GOVERNANCE DISASTERS Global povety Global instability New system of governance Smart sensors Global coordination Improvements to global governance Deliberate attempts to construct world dictatorship Technological innovations Enduring poverty Not achieving important ethical goals Climate change Lack of human flourishing Undesirable world system (e.g. global dictatorship) Global pollution Disruption to world politics and economy Total short-term casualties Collapse of world system Post-disaster politics General mitigation effort Long-term negative effects Civilisation collapse Extinction Failing to solve important problems Making things worse Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts Meta-uncertainty on tradeoffs between e.g. poverty, survival, freedom 80 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 1. Global coordination and cooperation will be important to any attempt to control ecological damage on a large scale and prevent “races to the bottom”. 2. Poverty is often seen as exacerbating ecological damage through unsustainable practices, while richer countries introduce environmental regulations – but richer nations exploit many resources (such as fossil fuels) in non-sustainable and damaging ways. 3. Transitioning to sustainable economies, or sustainable economic trajectories, could control ecological damage. 4. Research into sustainability could allow the construction of sustainable economies or environments at costs that people are willing to bear. 5. Climate change exacerbates the pressure on the ecological system by changing weather patterns and increasing natural disasters in ways ecosystems find hard to adapt to. 6. Global pollution is a visible source of ecological damage, one that global agreements have had moderate success at tackling. 7. Truly global preservation efforts may be needed for some threatened ecosystems that stretch beyond natural boundaries (e.g. in the seas and oceans). 8. Beyond general all-purpose mitigation efforts, addressing this threat could include the preservation of ecosystems, species or genetic codes, to allow a subsequent rebuilding. 9. New, profitable, but environmentally damaging industries could put extra strain on the ecosystem. 10. According to some systems of value, the loss of certain animals and ecosystems constitutes a moral tragedy in and of itself. 11. Humans derive much pleasure and many benefits from various parts of the ecosystem, and losing this would result in a loss to human quality of life. 12. Ongoing and continuous biodiversity loss is a clear consequence of ecological collapse. 13. Ecological damage can put the human food system in danger, triggering famines. 14. Ecological damage increases vulnerability to floods and other natural disasters. 15. Disruptions to the world’s political and economic systems could trigger further conflicts or instabilities, causing more casualties and impairing effective response. 16. Since a lot of the world’s carbon is locked up in trees, ecological collapse could exacerbate climate change. 17. The ecosystem is of great economic benefit to humanity, so its loss would have large economic costs. 18. Ecological damage is likely to be long-term: the effects will last for many generations. 19. Technological innovations may result in more sustainable economies, or in more environmentally damaging products. 20. It may be possible to ensure human survival in semi- “closed” systems (solar power, hydroponic food, distilled water), with minimal dependency on the external ecosystem. 21. Over the long term, it may become possible and necessary to go about rebuilding the ecosystem and healing its damage. 22. Political decisions will be the most likely factors to exacerbate or mitigate an ecological disaster. 23. It is unclear how dependent humans truly are on the ecosystem, and how much damage they could inflict without threatening their own survival. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 81 3.1 Current risks during 2013 3.1.3.3 Main events 22-Jan-13: Current extinctions probably the result of past actions; many future extinctions to come 242 – Research An estimated 40% of world trade is based on biological products or processes such as agriculture, forestry, fisheries and plant-derived pharmaceuticals, and biodiversity comprises an invaluable pool for innovations.243 And yet this biodiversity is being lost at an alarming rate – the rate of extinctions for plants and animals is 100 to 1,000 times higher than their pre-human levels.244 A variety of methods have been suggested to halt or slow this loss, ranging from putting an explicit value245 on biodiversity and ecosystem services (human benefits from a multitude of resources and processes that are supplied by ecosystems), 246 to performing triage on the most valuable species.247 This research paper suggests, however, that there is a lag of several decades between human pressure on the ecosystem and ultimate species extinction. This suggests that many extinctions will continue in decades to come, irrespective of current conservation efforts. 05-Apr-13: Ocean data added to Microsoft Eye on Earth project – Initiative In order to safeguard ecological resources, it is important to track and quantify them. This has traditionally been the role of governments or non-governmental organisations.248 Recently, however, private organisations have started developing tools to enable companies and individuals to track ecological damage and make decisions in consequence. One such tool was Eye on Earth, developed by Microsoft in alliance with the European Environment Agency and Esri.249 It was launched with three services – WaterWatch, AirWatch and NoiseWatch – keeping track of the levels of different pollutants, using official sources and inputs from citizens.250 This was subsequently expanded to include other environmentally sensitive pieces of information, such as the states of coral reefs and invasive alien species. It was primarily land-based, so the oceans were missing from this visualisation tool. This lack has been partially overcome with the inclusion of data from the MyOcean 2 project251 (partly funded by the European Commission). The data cover sea surface temperature, salinity and currents for the Mediterranean Sea and the Black Sea. 30-May-13: Improvement in managed fisheries in Europe 252 – Research Human action has been shown to be able to mitigate some ecosystem damage. Overfishing is expected by standard economic theory: the sea’s resources are a (global) common, where the rational behaviour of individual fishermen must lead to dilapidation of the resource.253 Unlike on land, where nature reserves or parks can be established, there are no easy ways of establishing property rights in the sea254 (thus privatising that “common”). A typical example of this behaviour is the collapse of the Grand Banks fisheries off Canada’s Atlantic coast in the 1990s, where cod biomass fell by over 95% from its peak and has currently not recovered.255 It is therefore significant that the European Union has been partly successful in its attempts to control over-fishing through legislation. For instance, despite the fact that North Sea cod remains vulnerable, there has been a recent increase in stock size and a decrease in fish mortality. This may point to the potential for further ecological improvements through well-chosen policy interventions. 82 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks Figure 18: Increase in the number of species assessed for the IUCN Red List of Threatened SpeciesTM (2000–2013.2). Source: http://www.iucnredlist.org/about/summary-statistics 02-Jul-13: About 21,000 Species Face Extinction, says International Union for Conservation of Nature (IUCN) 256 – Event In 2013 the IUCN added an additional 4,807 species to its Red List of Threatened Species. This brings the total to about 21,000. Some have argued that we are entering a new geological era in Earth’s history: the Anthropocene257, when human actions are one of the major impactors on the planet’s biosphere. The graph shows a fairly steady growth in the (estimated) number of threatened species. This steadiness may be illusory, as the biosphere shows signs that it may be approaching a planetary-scale tipping point, where it may shift abruptly and irreversibly from one state to another. As a result, the biological resources humans presently take for granted may be subject to rapid and unpredictable transformations within a few human generations.258 This could be seen as a great tragedy beyond purely human concerns, if animals (and animal welfare) are seen to have intrinsic value.259 Figure 17: Collapse of Atlantic cod stocks (East Coast of Newfoundland), 1992 Source: http://en.wikipedia.org/wiki/File:Surexploitation\_morue\_surp%C3%AAcheEn.jpg) Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 83 3.1 Current risks Extreme Climate Change Ecological Nanotechnology Nuclear War Catastrophe Global System Collapse Major Asteroid Impact Global Pandemic Future Bad Global Governance Super-volcano Synthetic Biology Artificial Intelligence Unknown Consequences 3.1 Current risks Pandemic 3.1.4 Global A pandemic (from Greek πᾶν, pan, “all”, and δῆμος demos, “people”) is an epidemic of infectious disease that has spread through human populations across a large region; for instance several continents, or even worldwide. Here only worldwide events are included. A widespread endemic disease that is stable in terms of how many people become sick from it is not a pandemic. 260 84 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 3.1.4.1 Expected impact disaggregation 3.1.4.2 Probability Influenza subtypes266 Infectious diseases have been one of the greatest causes of mortality in history. Unlike many other global challenges pandemics have happened recently, as we can see where reasonably good data exist. Plotting historic epidemic fatalities on a log scale reveals that these tend to follow a power law with a small exponent: many plagues have been found to follow a power law with exponent 0.26.261 These kinds of power laws are heavy-tailed262 to a significant degree.263 In consequence most of the fatalities are accounted for by the top few events.264 If this law holds for future pandemics as well,265 then the majority of people who will die from epidemics will likely die from the single largest pandemic. Most epidemic fatalities follow a power law, with some extreme events – such as the Black Death and Spanish Flu – being even more deadly.267 There are other grounds for suspecting that such a highimpact epidemic will have a greater probability than usually assumed. All the features of an extremely devastating disease already exist in nature: essentially incurable (Ebola268), nearly always fatal (rabies269), extremely infectious (common cold270), and long incubation periods (HIV271). If a pathogen were to emerge that somehow combined these features (and influenza has demonstrated antigenic shift, the ability to combine features from different viruses272), its death toll would be extreme. Many relevant features of the world have changed considerably, making past comparisons problematic. The modern world has better sanitation and medical research, as well as national and supra-national institutions dedicated to combating diseases. Private insurers are also interested in modelling pandemic risks.273 Set against this is the fact that modern transport and dense human population allow infections to spread much more rapidly274, and there is the potential for urban slums to serve as breeding grounds for disease.275 Unlike events such as nuclear wars, pandemics would not damage the world’s infrastructure, and initial survivors would likely be resistant to the infection. And there would probably be survivors, if only in isolated locations. Hence the risk of a civilisation collapse would come from the ripple effect of the fatalities and the policy responses. These would include political and agricultural disruption as well as economic dislocation and damage to the world’s trade network (including the food trade). Extinction risk is only possible if the aftermath of the epidemic fragments and diminishes human society to the extent that recovery becomes impossible277 before humanity succumbs to other risks (such as climate change or further pandemics). Five important factors in estimating the probabilities and impacts of the challenge: 1. What the true probability distribution for pandemics is, especially at the tail. 2. The capacity of modern international health systems to deal with an extreme pandemic. 3. How fast medical research can proceed in an emergency. 4. How mobility of goods and people, as well as population density, will affect pandemic transmission. 5. Whether humans can develop novel and effective anti-pandemic solutions. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 85 3.1 Current risks GOVERNANCE DISASTERS Global povety Global instability New system of governance Smart sensors Global coordination Improvements to global governance Deliberate attempts to construct world dictatorship Technological innovations Enduring poverty Not achieving important ethical goals Climate change Lack of human flourishing Undesirable world system (e.g. global dictatorship) Global pollution Disruption to world politics and economy Total short-term casualties Collapse of world system Post-disaster politics General mitigation effort Long-term negative effects Civilisation collapse Extinction Failing to solve important problems Making things worse Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts Meta-uncertainty on tradeoffs between e.g. poverty, survival, freedom GLOBAL PANDEMIC Contact with reservoir species Global poverty Small pandemic scares Density of population Medical research Bio-terrorism Global coordination Impact of increased movement of goods and people Antibiotics resistance Impact of sanitation or lack thereof Accidental release from lab Healthcare in individual countries Pandemic combining different deadly features Deadly pandemic Pandemic leaping the species barrier Impact of monoculture food supply Smart sensors Post-pandemic politics Disruption to world politics and economy Long-term fate of pandemic virus/ bacteria/parasite Impact on meat production and food supply Pandemic transmission Direct casualties Effectiveness of countermeasures Total short-term casualties Pre-pandemic medical contingency plans Civilisation collapse Meta-uncertainty of how the changed world Extinction has affected pandemic probabilities Meta-uncertainty of what probability distributions pandemics follow Uncertain events Key Meta-uncertainties Risk events Direct impacts Indirect impacts Current intervention areas Bad decisions Accidents Severe impacts 86 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks 1. Extensive medical research will be key to preventing and combatting large scale pandemics. The drawbacks are the possibility of accidental release of dangerous pathogens from laboratories and of bioterrorism. 2. As so much is known about pandemic risks compared with other risks, there are more possibilities for specific prepandemic contingency plans. 3. The effectiveness of healthcare systems will be important, especially in less developed nations where the pandemic may overwhelm the system, and then transmit from there to other nations. 4. Global coordination in detection, analysis and treatment are vital for stopping a pandemic in its early stages, and for implementing measures such as quarantines and more advanced countermeasures. 5. Poverty will affect the quality of national healthcare systems, population density and sanitation quality, the movement of local goods and people, and the effectiveness of the political response. 6. Bioterrorists may unleash a pathogen held in storage, such as smallpox. 7. Laboratory security at the top labs is insufficient for the danger at hand, and accidental release is a nonnegligible possibility. 8. Pandemics are one of the risks where there is a possibility for a very large number of direct casualties, depending on the severity of the pathogen. 9. Mass casualties and finger-pointing could destabilise the world political and economic systems. 10. If the pathogen is transmissible to farm animals, this could affect the world food supply. 11. It is unlikely the pathogen would be a recurrent, long-term risk, but variants of it could continue to affect people and animals for many years, dependent on its transmissibility and life cycle. 12. Small pandemic scares could improve global coordination on the issue. 13. Increased population density causes increased transmissibility of the pathogen, especially in urban slums. 14. Some pathogens, such as bird flu, depend on regular contact between humans and “reservoir species” in order to evolve into periodically dangerous strains. 15. If antibiotic resistance develops, humanity could see the resurgence of bacteria-based pandemics. 16. The increased movement of people and products increases the speed and spread of pandemic transmission. 17. Sanitation or its lack will strongly affect the spread of certain pathogens in key areas. 18. The efficiency of global reaction to a new pandemic will be strongly determined by the speed of research on the pathogen during the pandemic. 19. A great risk will arise if a pathogen combines the different dangerous features of current viruses or bacteria. 20. The improvements to surveillance and sensing technologies (including indirect detection via web queries or social media) open the possibility of smarter interventions (such as microquarantines) and faster understanding of the pathogen’s transmissibility. 21. Post-pandemic politics will be important for preventing a civilisation collapse or enabling reconstruction. 22. Many pathogens incubate in species close to humans, before leaping the species barrier. 23. Monoculture food systems make it easier to transmit any pathogen infecting human food animals. 24. The mode of transmission of the pathogen will be critical to its ultimate reach and impact. 25. Various countermeasures are available in terms of detection, virus analysis, treatment, and quarantining. Future research, technological and political developments may open up new methods of fighting the pathogen. 26. Many of the current factors determining pathogen transmission are unprecedented, such as movements of goods and people, the quality of healthcare systems, and the existence of a centralised political response. This means that data from past pandemics will not be as reliable for computing probability distributions. 27. The pandemic risk lies in the “tails” – the extreme events – and these tails must be estimated from few data points, making them tricky and uncertain. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 87 3.1 Current risks during 2013 3.1.4.3 Main events 10-Jun-13: Pandemic Influenza Risk Management: WHO Interim Guidance 278 – Policy This is an updated document that replaces the 2009 Pandemic Influenza Preparedness and Response: a WHO guidance document.279 It updates its recommendations based on lessons from the influenza A(H1N1) 2009 pandemic (swine flu),280 the adoption by the Sixty-fourth World Health Assembly of the Pandemic Influenza Preparedness Framework281 (for the sharing of influenza viruses and access to vaccines and other benefits), and the States Parties’ obligations on capacity strengthening contained in the International Health Regulations of 2005.282 Of significance was the Report of the Review Committee on the Functioning of the International Health Regulations (2005) on the A(H1N1) 2009 pandemic,283 which concluded: “We were lucky this time, but as the report concludes, the world is ill-prepared to respond to a severe influenza pandemic or to any similarly global, sustained and threatening public-health emergency.” This is reinforced by the fact that the 2009 pandemic is alleged to have infected 24% of the population.284 The main lesson the WHO drew from that epidemic was that member states generally had communication issues (between ministries of health and decision,makers, and with the public), and were prepared for a pandemic of high severity and appeared unable to adapt their national and subnational responses adequately to a more moderate event. The guidance paper indicates simultaneously the weaknesses of pandemic preparations, the improvements in these preparations, and the continued role of the WHO as global directing and coordinating authority. 24-Jul-13: Bacteria become resistant to some of the last remaining antibiotics 285 – Event Bacterial infections, such as the Black Death, 286 syphilis, 287 and tuberculosis, 288 have been responsible for millions of deaths, over the thousands of years they have co-existed with humanity. Though these diseases have not been eradicated – overall, a third of the world is currently infected with the tuberculosis bacillus289 – they have been controlled since the introduction of antibiotics, and prognostics have improved tremendously. But recently a rising number of bacteria have developed antibiotic resistance, due mainly to antibiotic over-prescription290 and use in livestock feed.291 This Nature report highlights the worrying way in which Enterobacteriaceae (bacteria with a 50% mortality rate) have become resistant to carbapenems, one of the last remaining antibiotics that had been effective against them. 09-Aug-13: Epihack: Digital disease surveillance hack-a-thon 292 – Initiative Beyond the formal, top-down initiatives to deal with pandemics, there are openings for bottom-up, innovative ideas. Epihack attempted to generate just such ideas, through three days of designing and hacking in Cambodia. Descriptions of the winning projects were given: – CoPanFlu: This project included home visits to collect blood samples from 807 homes and weekly follow-up phone calls to document the occurrence of infectious respiratory symptoms. These visits and phone calls caused disturbance to the participants. The new system uses SMS for users to report symptoms. Chart and map visualisation of the data (with full case details) and a fieldwork tracking tool were developed to help the research team analyse and monitor data. – DoctorMe: In addition to all of the popular features of DoctorMe (free health information for the general public), the tool now features a weekly survey for users. The survey will ask participants to select whether they are experiencing any symptoms from a list. 88 Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 3.1 Current risks – ILI Surveillance, Bureau of Epidemiology Thailand: The old system was web-based and had no visual element. The new mobile application and website provides a map visualisation for the reported cases of influenza-like illness (ILI) in Thailand. The map shows hospital ILI cases with colour-coded pins to indicate the level of ILI and allows for simple analysis of the situation. – Mae Tao Clinic: The electronic records for this healthcare clinic were very basic. During EpiHack, the data was moved to the cloud and is now open-source. A data visualisation dashboard was created to allow for map visualisation of diagnoses. The staff at Mae Tao Clinic can now easily view and analyse the data to spot trends and send alerts. They plan to pilot this programme at their clinic and, if successful, to replicate it with other clinics. – Verboice: The technology platform of Verboice is so user-friendly it doesn’t require technical developers to develop the systems. At EpiHack, project managers were able to design and create systems to address needs in their work completely on their own. In just eight hours, four project managers each completed their own voicebased participatory surveillance systems to monitor One Health in Kenya and Tanzania; early warning generation in South Sudan; animal health in Laos; unexploded ordnance in Laos; child trafficking in Cambodia. The project owners of these new systems will now take them back to their countries and develop implementation and sustainability plans. 22-Sep-13: Research hints at possibility for universal flu vaccine 293 – Research The Spanish flu outbreak was the deadliest short pandemic in history, infecting about a third of the world population (≈ 500 million people) and killing 50-100 million people.294 There have been numerous flu pandemics in the last few centuries, with three others having around a million casualties (the 1889-1890 Russian Flu,295 the 1957-1958 Asian Flu, and the 1968-1969 Hong Kong Flu296 outbreaks). The most recent pandemic was that in 2009, which killed 150,000-500,000 people.297 Thus any move towards a universal flu vaccine would be of great importance to combating such recurring pandemics. This paper, analysing the role of T cells in combating influenza, suggests a way that such a vaccine could be feasible. 28-Nov-13: Difficulties in containing the accidental laboratory escape of potential pandemic influenza viruses 298 – Research Biosafety laboratories experiment with some of the deadliest of the world’s pathogens, and occasionally create new ones.299 Their number is increasing globally, and their safety record is far from perfect, with several pathogen leaks reported300 and others suspected301 (the last smallpox fatality was due to a virus that escaped a lab302, after eradication of the virus in the wild). The rate of pathogen escape has been estimated at 0.3% per laboratory, per year303 – a very high probability, given the 44 BSL-4304 labs and several thousands of BSL-3 labs. There have already been three known escapes from BSL-4 labs since 1990.305 This report uses an agent-based model to analyse whether the accidental laboratory release of pandemic flu viruses could be contained, and concludes that controllability of escape events is not guaranteed. 3-Dec-13: Global pandemic tops poll of insurance industry risks 306 – Initiative Academics and governmental307/ supra-governmental308 organisations have long worried about the risks of pandemics. But such organisations attract certain types of people with specific outlooks, who can be subject to further biases because of their profession and the social milieu surrounding it.309 Insurers come from a different background, focusing on practical profitability in the business world. It is therefore instructive that they too see pandemics as among the major threats in the world today. This also implies that combating pandemics is of use not only from a humanitarian but also from an economic standpoint. Global Challenges – Twelve risks that threaten human civilisation – The case for a new category of risks 89 3.1 Current risks System Collapse 3.1.5 Global 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 efficiency322 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. T

he productivity of modern societies is largely dependent on the careful matching of different types of capital325 (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.

#### It's slow and in 140 years.

Drmola & Hubík 18 Mgr. Jakub Drmola, PhD, Political Sceince Professor at Masaryk University. Tomáš Hubík, Computer Science PhD Candidate at Charles University in Prague, Systems Dynamics UiB at the University of Bergen. [Kessler Syndrome: System Dynamics Model, Space Policy, 44–45, 29–39, ScienceDirect]//BPS

It must be stressed that the model was not designed with such long outlooks in mind, and many of the assumptions will certainly not hold over the next 200 years (such as static launch rate growth, size, and structure of the satellites, their lifetime, evasion rates, lack of mitigation, and many others). But in the overwhelmingly unlikely case that these assumptions stay true, the simulated outcome seems to suggest a collapse of sorts around the year 2163. However, it does not look like a suddenly triggered chain reaction leading to widespread fragmentation of the entire LEO but rather like a gradually reached point at which LEO is so full of debris, and the rate of active satellite fragmentation is so high (almost one every day) that the launches cannot keep up anymore. This is consistent with the findings reported by LaFleur and Finkelman, who found the debris system to be unconditionally stable [18], [19], [27].

#### Kessler agrees.

Burns Interviewing Kessler 13 Corrinne Burns, interviewing Donald Kessler, who made up the concept. [Space junk apocalypse: just like Gravity? 11-15-2013, https://www.theguardian.com/science/blog/2013/nov/15/space-junk-apocalypse-gravity]//BPS

Now? Are we in trouble? Not yet. Kessler syndrome isn't an acute phenomenon, as depicted in the movie – it's a slow, decades-long process. "It'll happen throughout the next 100 years – we have time to deal with it," Kessler says. "The time between collisions will become shorter – it's around 10 years at the moment. In 20 years' time, the time between collisions could be reduced to five years." Fortunately, communications satellites are, in the main, situated high up in geosynchronous orbit (GEO), whereas the risk of collisions lies mainly in the much lower, and more crowded, low Earth orbit (LEO). But that doesn't mean we can relax. "We've got to get a handle on it – we need to prevent the cascade process from speeding up." And the only way to do that is, he says, to begin actively removing junk from space. Charlotte Bewick agrees. She's a mission concepts engineer with the German space technology company OHB System, with special expertise in space junk – specifically, how we can capture it and bring it back to Earth. While agreeing with Kessler that the movie scenario is exaggerated, she remains concerned. "Fragments of junk can naturally re-enter the atmosphere [and so be removed from orbit]. But we're at the stage where the rate of creation of new debris fragments is higher than the rate of natural removal. The orbits most at risk harbour important space assets – satellites for weather forecasting, oil spill and bush fire detection, and polar ice monitoring." Bewick highlights the case of Envisat, a defunct 8,000kg spacecraft circling Earth in an orbit that is very popular with space agencies and, hence, pretty crowded. "If Envisat collides with a piece of debris or a micrometeorite, the fragments could render the whole orbital region unusable." So can we get the junk down, I asked Massimiliano Vasile, part of the Mechanical & Aerospace Department at the University of Strathclyde and co-ordinator of the Stardust network. He told me defunct satellites in the high GEO region have, for some time, been shifted to higher "graveyard orbits" to keep them out of the way. But that's not an option for items in low Earth orbit. For this, he tells me, researchers are looking seriously into active debris removal – in-orbit capture techniques like harpooning, netting and tethering, the use of contactless systems like ion-beams or lasers, and even onboard robotics to position the junk away from high-risk orbital regions. As for middle Earth orbit – well, ideas are welcome, he says. We're in no immediate danger from Kessler syndrome – but it's not a problem that's going away. Despite Gravity's artistic license, Donald Kessler is pleased to see the phenomenon represented on the big screen. "It is very improbable that events would play out as they did in the film," he says. "But if it raises awareness, then that's great."

### 1NC - AT: Cyber

#### Megaconstellations function as critical infrastructure that increase resiliency and protect against cyberattacks

Hallex and Cottom 20 [Matthew A. Hallex is a Research Staff Member at the Institute for Defense Analyses. Travis S. Cottom is a Research Associate at the Institute for Defense Analyses. “Proliferated Commercial Satellite Constellations: Implications for National Security.” 2020. https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97\_20-29\_Hallex-Cottom.pdf?ver=2020-03-31-130614-940]

While potentially threatening the sustainability of safe orbital operations, new proliferated constellations also offer opportunities for the United States to increase the resilience of its national security space architectures. Increasing the resilience of U.S. national security space architectures has strategic implications beyond the space domain. Adversaries such as China and Russia see U.S. dependence on space as a key vulnerability to exploit during a conflict. Resilient, proliferated satellite constellations support deterrence by denying adversaries the space superiority they believe is necessary to initiate and win a war against the United States.28 Should deterrence fail, these constellations could provide assured space support to U.S. forces in the face of adversary counterspace threats while imposing costs on competitors by rendering their investments in counterspace systems irrelevant. Proliferated constellations can support these goals in four main ways. First, the extreme degree of disaggregation inherent in government and commercial proliferated constellations could make them more resilient to attacks by many adversary counterspace systems. A constellation composed of hundreds or thousands of satellites could withstand losing a relatively large number of them before losing significant capability. Conducting such an attack with kinetic antisatellite weapons—like those China and Russia are developing—would require hundreds of costly weapons to destroy satellites that would be relatively inexpensive to replace. Second, proliferated constellations would be more resilient to adversary electronic warfare. Satellites in LEO can emit signals 1,280 times more powerful than signals from satellites in GEO.29 They JFQ 97, 2nd Quarter 2020 Hallex and Cottom 25 also are faster in the sky than satellites in more distant orbits, which, combined with the planned use of small spot beams for communications proliferated constellations, would shrink the geographic area in which an adversary ground-based jammer could effectively operate, making jammers less effective and easier to geolocate and eliminate.30 Third, even if the United States chooses not to deploy national security proliferated constellations during peacetime, industrial capacity for mass-producing proliferated constellation satellites could be repurposed during a conflict. Just as Ford production lines shifted from automobiles to tanks and aircraft during World War II, one can easily imagine commercial satellite factories building military reconnaissance or communications satellites during a conflict. Fourth, deploying and maintaining constellations of hundreds or thousands of satellites will drive the development of low-cost launches to a much higher rate than is available today. Inexpensive, high-cadence space launch could provide a commercial solution to operationally responsive launch needs of the U.S. Government. In a future where space launches occur weekly or less, the launch capacity needed to augment national security space systems during a crisis or to replace systems lost during a conflict in space would be readily available.31

#### Falco says the problem is satellite computer systems, that’s an alt cause from the public sector --- AFF doesn’t solve. Haven reads green.

Falco 19 “Opinion: Our satellites are prime targets for a cyberattack. And things could get worse.” Gregory Falco [Gregory Falco is a cyber research fellow at Harvard University’s Belfer Center and a postdoctoral security researcher at the Massachusetts Institute of Technology’s Computer Science and Artificial Intelligence Laboratory. He is the founder and chief executive of NeuroMesh, a tech security company.] May 7, 2019 <https://www.washingtonpost.com/opinions/our-satellites-are-prime-targets-for-a-cyberattack-and-things-could-get-worse/2019/05/07/31c85438-7041-11e9-8be0-ca575670e91c_story.html> SM

One minute. That’s how long it took me last month to demonstrate to a major broadcasting company and production team how to access and restart a leading satellite Internet provider’s control system. Five minutes is how long it took me to demonstrate how to gain full control of it.

Hackers are always improving their ability to break into our digital infrastructure. Yet the computer systems running our satellites haven’t kept up, making them prime targets for an attack. This makes our space assets a massive vulnerability — and it could get much worse if we’re not careful.

This past weekend, SpaceX won approval from the Federal Communications Commission to increase the number of low-flying satellites as part of its Starlink project so that they can provide faster Internet access to the world. Unfortunately, access will be faster for both legitimate users and hackers alike. The FCC does not require applicants to publicly demonstrate how they will secure these satellites or the Internet they plan to provide. SpaceX, like other private space companies, has shared virtually no information about its cybersecurity efforts or plans.

This is extremely disconcerting, considering the potential ramifications of a satellite being hacked. The most mundane outcome is that the satellite will no longer function, but the other extreme is for an attacker to break into a satellite and take over any thrusters (which SpaceX has insisted its satellites will have) and then propel the satellite into critical infrastructure and military satellites in other orbits. In other words, attackers could possibly use the hacked satellite as a kinetic weapon.

There has long been a void of attention to securing space infrastructure, ranging from space-faring rovers to satellite ground-control systems that manage all the space-based assets. Virtually no policy or oversight agency exists concerning securing space assets — something I’ve discussed with government leadership to little avail. While the FCC regulates communications, it should not necessarily be responsible for all things space security. Perhaps the new Space Development Agency could be.

This leaves space security in the hands of the private sector, which is exploiting the recent ease of access to space. The advent of small satellites known as CubeSats offers the chance to launch a satellite into orbit for as little as $30,000 . And because the government wants to encourage economic activity in this area, requirements to do so are extremely light. This leaves those who are creating the satellites responsible for the cybersecurity of their assets, which is not usually part of the rocket scientist’s traditional skill set.

As a space cybersecurity researcher, I am excited about the renewed interest in space from both the commercial and exploratory perspectives. But we need to be strategic about the security of these space systems. Unlike “Internet of things” devices such as baby monitors, which we purchase for less than $100 and discard or sell once a new model comes out, satellites often remain in orbit for much longer and are less dispensable. So if we don’t consider the cybersecurity of the space asset now, we’ll likely be dealing with the ramifications of that for several years to come. The lack of government intervention in satellite security does not mean that we can ignore cybersecurity as an issue.

Private space companies such as SpaceX, OneWeb and Blue Origin need to join the conversation about cybersecurity and help consumers understand that they are taking it seriously (if they are). (Blue Origin’s founder and owner, Jeff Bezos, also owns The Post.) Right now, there are several job openings for information security analysts at private space companies, indicating that they are likely hurting for talent and are behind in figuring out their security. This isn’t surprising given that space is hard, and traditional IT experts don’t have the right skill sets for a space cybersecurity job. Space systems have unique requirements that are more akin to an industrial control system, such as an energy smart meter, than to an email server.

Private space companies need to start a dialogue with the security research community about their particular challenges so that we can help. They should also be transparent with the FCC that they need help in securing their infrastructure. The last thing we need is for China or Russia to take over SpaceX’s satellites and wreak havoc on our space assets.

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