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Great Power Conflict

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Executive Summary

Conflict between Great Power countries has had a strong influence on the course of history. This pattern seems likely to continue into the 21st century. Great Powers are states with global interests and the military strength to defend them against their rivals. In the 21st century, the United States, China, and potentially India and Russia will have this status. Leaders in those countries will have to choose how to cooperate and compete in the decades to come. The effects of the decisions they make will be felt in many domains, including how emerging technologies are developed and governed, whether they are able to coordinate to solve global problems, and whether the Great Power peace that has prevailed since World War II will continue. The danger new competition poses appears even greater when considered from a [longtermist](#) perspective, paying particular attention to the potential effects on future generations.

This report intends to advise philanthropic donors who want to help reduce this danger. In it, we discuss the risk Great Power conflict poses, recommend effective funding opportunities to reduce that risk, and estimate the cost-effectiveness of this work to allow for cross-cause comparisons. First, the concept of Great Power competition is defined and the existing academic literature on its causes is briefly reviewed. Second, estimates of the probability of future conflict between today's Great Powers are made using several different methods. Third, the pathways through which Great Power competition this century can affect the long-term future by increasing the probability of a global catastrophe are defined and discussed. Fourth, the available evidence on effective strategies to reduce these risks is summarized. Fifth, specific funding opportunities are recommended, along with relevant uncertainties and open questions.

We emphasize that a wide range of outcomes for Great Power conflict in the coming century remain possible. There could be all-out war, renewed cooperation to solve important problems, or an outcome somewhere in between with a mix of conflict and cooperation. Philanthropists have an opportunity to nudge humanity towards a peaceful outcome and away from a dangerous one. Specific funding opportunities Founders Pledge recommends in this area can be found on our website.

The risks of international tension and causes of war

We think about the long-term significance of Great Power conflict by considering its effect on *existential risks*. Such risks are events that, if they occurred, would cause human extinction, a permanent collapse of global civilization, or a complete halt in growth and progress. Any one of these outcomes would prevent humanity from achieving its long-term



potential, precipitating unprecedented suffering for everyone alive today and preventing all generations to come from living happy lives.

Great Power conflict is a *risk factor*. It plausibly increases the chance that a host of other bad outcomes come to pass. International tensions clearly increase the chance that a war breaks out. If that war involved the widespread use of weapons like thermonuclear warheads, it could cause enough damage to threaten civilizational collapse, or leave humanity in a weakened state and vulnerable to subsequent disasters like a pandemic. But more tense relationships between Great Powers can increase our vulnerability to global catastrophic risks even if they don't lead to all-out war. For example, they may make countries more likely to invest in riskier technological development and less likely to coordinate to solve global problems like climate change.

Researchers typically investigate the causes of war at five levels of analysis: the individual level, the substate level, the state level, the bilateral level, and the international system level. Wars are complex, multi-causal events. In order to predict when future wars are likely to occur, we will consider multiple causes at different levels of analysis. The different levels also present a useful framework for thinking about different possible intervention points for philanthropists.

At the *individual level*, attention is focused on the role of individual decision-makers and the cognitive patterns that shape their behaviour. An example of an intervention at this level could be providing information or training to change these decision-making processes. At the *substate level*, researchers consider how group decision-making processes, such as those used by cabinets or committees, affect when and why leaders choose to go to war. Groups tend to fail to consider all options or use shortcuts and heuristics rather than comprehensive analysis, providing another potential intervention point. At the *state level*, we consider which characteristics of countries make them more or less prone to war. The evidence suggests that larger, more powerful states are more aggressive than smaller states, emphasizing the dangers posed by Great Power tensions. At the *bilateral level*, relationships between pairs of states are considered. This is an important analytical frame: we see that sets of states which share a border or have territorial disputes are far more likely to go to war than other sets of states, that past rivalries make future escalation and conflict more likely, and that pairs of democracies are much less likely to fight than pairs of countries where at least one member is authoritarian. Finally, the *international system level* considers which distributions of global power are most stable and least likely to experience conflict. We see that periods of power transition—when one state is growing more quickly than the current global leader—seem particularly dangerous.



Historical trends and predictions of future conflict

With a better understanding of important factors that increase or decrease the risk of war, we consider the likelihood of conflict in the future, over roughly the next 100 years. To do this, we first identify which countries are likely to be involved in Great Power competition. We find that, barring a transition to a new economic growth mode (like an acceleration spurred by the invention of a breakthrough technology or a collapse caused by a global disaster), China, the United States, and likely India will be by far the world's three largest economies in the 21st century. In addition to these three economic superpowers, we also consider Russia a Great Power for the purposes of this report by dint of its large nuclear arsenal and demonstrated willingness to project power beyond its borders.

We estimate the future likelihood of conflict in a few different ways. First, we consider a historical baseline: in the modern era, humanity has experienced roughly two major wars per century. Second, we consider a statistical model where about one war of any size occurs every two years, and the size of the war, as measured by the per capita number of battle deaths, is drawn from a Pareto distribution with a very long tail. This means that most wars have relatively few deaths, but the worst wars will have many thousands of times more deaths than the average. The possibility of very bad outcomes ("tail risks") makes the risk of war very high. Finally, we consider a model where, for a number of factors, the baseline risk of war is considerably lower following World War II than it was before.

To make an all-things-considered prediction, we assign subjective credences to each of these three models based on our judgement of the strength of the arguments behind them and how well they explain the available data. This calculation suggests that there is about a one-in-three chance of a major war breaking out in the next 100 years. It is worth noting that this is the risk of a war on the scale of World War II, or potentially much larger given how much the global economy, population, and total war-making capacity has grown since 1945. An all-out war between modern Great Powers could be far more destructive than any historical comparison.

Great Power conflict and the long term

How serious would such a conflict be? We consider its long-term implications by tracing the sequences of events that could connect Great Power tension to existential catastrophe. We identify five such "pathways to catastrophe":

1. Catastrophes otherwise mitigated by global cooperation
2. Technological disaster



3. Nuclear war
4. Totalitarian lock-in
5. War followed by subsequent disasters

We describe for each pathway how, tangibly, Great Power tension could actually cause an unprecedented global catastrophe this century. We note that, at least for pathways 1 and 2, conflict could lead to catastrophe without a single missile being launched simply by harming the international community's ability to coordinate and solve other serious problems.

At the end of the section, we present a statistical model that includes our subjective estimates for the relative likelihoods of each step in the causal chains we identified. This model allows us to calculate the relative risk posed by each of the pathways. After calibrating the model by comparing it to the few other attempts at estimating long-term risks from Great Power conflict, we are able to advance some tentative conclusions about which pathways are most concerning based on the amount of risk they pose. We find that most of the risk comes from the pathways to catastrophe which result from a breakdown in international cooperation or involve risks from emerging technologies like advanced artificial intelligence.

Evaluating interventions

We use our tentative prioritization of risk pathways to inform our evaluations of the different interventions a philanthropist could fund in this space. To reflect the high degree of uncertainty we must contend with in this space, we introduce a model based on expected value reasoning: considering a range of potential outcomes for funding an intervention, and weighting them based on how probable we expect them to be. We note that interventions in this space often have large downside risks in addition to large upside risks: they may have a chance of bringing about bad outcomes as well as good ones. This pushes us to look for interventions for which downside risk is minimized, making them highly valuable in expectation.

We also look at funding data for philanthropists currently active in this space to look for neglected opportunities. Nuclear issues are relatively well funded in comparison to issues regarding emerging technologies (note that one could still consider nuclear issues relatively underfunded in comparison to other philanthropic cause areas). Considering that it seems likely that the bulk of the long-term risk from Great Power conflict is related to how it affects the development of emerging technologies, we encourage donors to look for opportunities to fund research and diplomacy initiatives related to emerging technologies. We also note that Track II diplomacy initiatives, which involve bringing together



non-governmental representatives from two countries, like scientists or businesspeople, to share information and discuss mutual problems, appear highly neglected. Since there are theoretical and empirical reasons to believe that Track II diplomacy can play an important role in dispute resolution, especially when official diplomatic channels are strained or even fully cut off, we think this is a highly-promising intervention.

The specific funding opportunities we currently recommend based on these findings can be found on our website.

Discussion and conclusion

We conclude by discussing the report's limitations and final take-aways. It should be noted that this report is a first step towards understanding the relationships between Great Power tension, war, and longtermism rather than the final word on this extremely complex topic. We raise many questions and directions for future research, including more analysis of alternative future scenarios (including growth accelerations and collapses) and more robust comparisons between the benefits of funding work in this cause area and funding work in other longtermist cause areas like biosecurity.

Despite these limitations, we believe this report represents a useful contribution that will help allow philanthropists who worry about rising tensions between Great Power countries to act more effectively to reduce them. To reiterate, there are still multiple paths humanity could follow in the years to come. Shifting us towards peaceful outcomes could prove a hugely important mission.



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1. Introduction

Competition between Great Power states—countries with global interests and the military strength to defend them against their rivals—has had a strong influence on the course of history. The Napoleonic Wars redrew the borders of Europe. World War II allowed the United States and the Soviet Union to emerge as dueling superpowers. The resultant Cold War sparked ideological conflicts around the world, accelerated the development of technology like rocketry and computers, and led to the growth of stockpiles of thousands of nuclear weapons. And, of course, each of these conflicts led to fighting around the world that caused hundreds of thousands or millions of casualties.

Great Power competition is likely to continue in the 21st century in one form or another. The United States still exerts influence over the international system, but its economy has recently been overtaken by China's. The emerging geopolitical order is, for now, bipolar, balanced between two superpowers with vastly different histories, cultures, political systems, and interests. Tensions seem to be rising as the countries clash over trade terms, territory, and their preferred ways of governing the international system. Meanwhile, India's population is on the verge of surpassing China's. If it can maintain its high growth rate, India may rival both the U.S. and China in terms of international influence before the end of the century. And Russia, while economically much weaker than any of these other countries, maintains a nuclear arsenal larger than any other country on earth and has shown a willingness to project power beyond its borders.

The choices leaders in these countries make in the coming decades will send humanity down one of many possible paths. They may prove able to navigate this complex landscape without descending into all-out conflict, as the U.S. and Soviet Union did during the Cold War. Perhaps they can also find ways to work together to solve global coordination problems like climate change. Or, they may be drawn into an ever-escalating rivalry. A breakdown in international cooperation would have severe consequences. The war-making capacity of modern Great Powers is greater than any historical analogue, bolstered by the size of these countries' economies and the modern weapons technologies they possess. An all-out war would be devastating. But even if these countries avoid direct confrontation, their failure to cooperate would leave our species more vulnerable to a range of other global catastrophic risks, from climate change and pandemics to the dangers posed by transformative new technologies like advanced artificial intelligence systems.

It is difficult to predict which path we will end up following: peaceful cooperation, ruinous conflict, or something in between. What we can say is that, whichever path we choose, the effects will be felt for a very long time. The next 100 years could see humanity continue to make progress, safely develop new technologies, and learn how to apply them to spread



prosperity around the globe. Or our technological sophistication could bring us to ruin, trapping us in a dystopian state or wreaking havoc on our civilization, ruining the lives of not just everyone alive today, but all our potential descendants as well. How the Great Powers manage their relations over the coming decades is not the only factor driving us down one of these paths, but it is likely to be a powerful nudge in one direction or the other.

This report investigates what philanthropists can do to push humanity towards the prosperous path and away from the disastrous one. To make recommendations, we have reviewed the literature on the causes of war and the policies that promote peace and consulted with experts. We have quantified the importance of different areas within this cause in terms of risk and gathered data on which issues are relatively neglected by other funders. This has allowed us to select interventions which we believe have the best chance of making a difference at the current margin, and identify promising research projects which could meaningfully advance our knowledge and make future work more effective. Given the complexity of the issues under investigation, these interventions carry some risk of failing to have impact. But the stakes are high enough, and the evidence sufficiently strong, that we believe they represent good bets for philanthropists looking to have a long-term impact by promoting global peace.



2. Scope and Conceptual Framework

This report explores issues at the intersection of international relations, conflict studies, and longtermism.¹ In it, we draw extensively on the mainstream international relations literature but focus specifically on understanding the potential effects of war on the long-term future. Taking a long-term view focuses our attention on the risk a Great Power war poses to humanity's future potential. Extinction, an unrecoverable collapse of civilization, or a permanent end to humanity's growth and progress would all destroy the long-term potential of our species. We call events that could lead to one of these scenarios *existential risks*.² Such an event, if it occurred, would be unprecedented in human history. It would cause unimaginable suffering for everyone alive today and extinguish any possibility for trillions of our would-be descendants to live happy lives.

Some of these global catastrophic risks, like an asteroid impact, are *direct risks*. By contrast, Great Power conflict is a *risk factor*: it is connected to multiple other risks, and raising or lowering the amount of conflict affects the seriousness of the threats we face in these other areas. In section 4 of this report we consider several concrete pathways through which Great Power conflict poses a global catastrophic risk. We will sort these pathways into three broad categories.

First, we consider ways in which Great Power conflict poses a risk even without a full-blown war breaking out. For example, a new Cold War could hasten the development of dangerous technologies or cause a breakdown in cooperation that precludes international agreements to mitigate other existential risks. Second, a Great Power war could itself be a global catastrophic risk. In an all-out war between Great Power nations, weapons with the potential to kill everyone on earth or irreparably damage civilization could be used. Or, in the aftermath of a major war, the victorious side could emerge as a global hegemon that is able to use advanced technologies to lock in its sub-optimal values.³ Third, a Great Power war could weaken humanity and leave us more vulnerable to subsequent disasters, like a serious pandemic.

The purpose of this report is to estimate the magnitude of these risks and recommend opportunities for philanthropists to reduce them. We consider such questions as:

¹ For an introduction to the concept of longtermism, see Stephen Clare and Sijr Hoeijmakers, "The Case for Longtermism and Safeguarding the Future," *Founders Pledge* (blog), November 30, 2020, <https://founderspledge.com/stories/the-case-for-longtermism-and-safeguarding-the-future>.

² We refer readers interested in an accessible overview of existential risks to: Toby Ord, *The Precipice: Existential Risk and the Future of Humanity* (Bloomsbury Publishing, 2020).

³ H/T to Sijr Hoeijmakers (Founders Pledge) and Michael Aird (Rethink Priorities) for discussion on this point in particular



- How likely is it that a large-scale global conflict occurs in the coming century?
- What are the root causes of such a conflict?
- Which countries are likely to be involved?
- How could such a conflict affect the long-term future, if at all?
- What can philanthropists do to reduce these risks?
- How impactful are interventions that focus on global cooperation compared to other risk-reducing approaches that focus on specific threats or technologies?

None of these questions are easy to answer. Geopolitical forecasts are highly uncertain and the evidence on the drivers of war and effective interventions is weak. Nevertheless, in the final sections of this report we suggest some approaches that seem likely to have positive effects in expectation. To make recommendations, we select interventions that have evidence of effectiveness, are recommended by experts, have high upside and low downside risk, and are most neglected by other philanthropists. We end the report by identifying our key uncertainties and promising directions for future research.

First, though, we define the key concepts we use to understand these issues. We discuss how scholars of international relations analyze the international system and review the literature on the causes of war. In the second section, we combine these findings with the principles of forecasting to estimate future trends in conflict. Then we discuss the implications of these trends for the long-term future. In part 2 of the report, we review possible interventions, the evidence for and against them, and the philanthropic landscape for this cause. Finally, in part 3 we make specific recommendations for philanthropic funding opportunities. We tentatively compare the impact of these funding opportunities to opportunities in other longtermist cause areas before closing with some recommendations for future work in this area.

The study of war

The study of war and its causes is in the domain of international relations. In fact, the topic is central to the discipline's history. International relations developed into a distinct academic field after World War I⁴ as scholars sought to understand why wars have occurred in the past and how they may be prevented in the future.⁵ Early researchers sought to find

⁴ "it was not until the slaughter of 1914–18 persuaded a number of influential thinkers and philanthropists that new ways of thinking about international relations were required that the field of IR emerged" Chris Brown and Kirsten Ainley, *Understanding International Relations*, 3rd ed (Houndmills, Basingstoke, Hampshire ; New York: Palgrave Macmillan, 2005), 19.

⁵ "For many historians of the time [following World War I], the intellectual question which eclipsed all others and monopolized their interest was the puzzle of how and why the war began" Scott Burchill and Andrew Linklater, "Introduction," in *Theories of International Relations*, ed. Scott Burchill and Andrew Linklater, Third edition (New York: Palgrave Macmillan, 2005), 6.



norms and laws that could make global relations more peaceful and cooperative. Many supported new institutions like the League of Nations and international law in the hopes that they would ensure peace.⁶ While their hopes were dashed by the outbreak of World War II less than 20 years later, about a third of IR scholars still conduct their research with immediate policy applications in mind.⁷ Over the last hundred years, a huge body of literature on war and conflict has been produced. While many open questions remain, on several important issues consensus has emerged.

In this report, we will draw on findings from both the theoretical and empirical side of this literature. Relative to fields like global health, theory plays a larger role in this field because:

- We cannot collect experimental data
- The sample size is inherently small: there are only 195 countries in the world, and very few of these are considered Great Powers
- Wars, especially large ones, are relatively rare
- The international system of geopolitical relationships is extremely complex: many variables are influential and changing simultaneously. This leads to unexpected or emergent effects and non-linear effects (such as the sudden outbreak of a war)
- It is difficult to collect data on many critical variables, such as international tension
- Especially with regards to military strategy and decision-making, states are secretive and official accounts may be unreliable
- Most of the reliable data we have to work with are from European conflicts that occurred in the 19th and 20th centuries. This makes it difficult to generalize from empirical studies.

Given these complications, theorizing is important because it suggests which parts of the system are most likely to be important and which variables we should focus our analysis on. Where we lack clear, measurable outcomes to track, we can focus on intermediate variables that our model of the system suggests are important. The credibility of different theories can also be informally tested by measuring how well they explain past events or how accurate their past predictions have turned out to be.

⁶ “Liberal internationalism, cluster of ideas derived from the belief that international progress is possible, where progress is defined as movement toward increasing levels of harmonious cooperation between political communities [...] In the interwar period, internationalists focused on defending and then reforming the League of Nations and developing international law” Duncan Bell, “Liberal Internationalism,” in *Encyclopedia Britannica*, accessed May 21, 2021, <https://www.britannica.com/topic/liberal-internationalism>.

⁷ “33% of scholars in the 2008 TRIP survey said that they had an immediate policy application in mind when conducting their research” Daniel Maliniak et al., “International Relations in the US Academy,” *International Studies Quarterly* 55, no. 2 (June 2011): 456, <https://doi.org/10.1111/j.1468-2478.2011.00653.x>.



At the same time, a theory-heavy approach has its drawbacks. Its conclusions are usually more contestable, it can lead us to make mistaken assumptions, and it can leave us more susceptible to cognitive biases and errors. There may be compelling arguments for competing theories. And different theories may offer competing explanations for past events depending on which aspects of those events are focused on or which data are considered important.

Historically, different theoretical assumptions about values, actors, and system dynamics have sparked debates among researchers in the field.⁸ In this report we draw on three main theories: realism, neoliberalism, and constructivism.

- Realist analyses typically assume states make decisions with the goal of maximizing their own utility. The analytical focus is directed towards a state's interest and the global balance of power.
- Neoliberal analyses similarly focus on utility maximization, but further consider how self-interested, rational states can cooperate when mutual gains are possible and institutions exist to facilitate cooperation
- Finally, constructivists emphasize the role norms play in determining state actions directly.⁹ For example, a state's identity—perhaps as democratic, or developing, or hegemonic—will influence which norms it sees itself as following. Constructivist scholars emphasize that their approach allows them to consider a broader range of variables that bear on state decision-making.

These three theories are complemented by a number of alternative or “radical” theories like Marxism, feminism, and postmodernism.¹⁰ It is also worth noting that realism, neoliberalism, and constructivism are especially dominant in the U.S., while there are yet more theories that hold considerable sway among scholars in Europe and China, for example.

Ultimately, the divergence of these different perspectives is less troublesome than it may seem. Most peer-reviewed articles do not advance an argument strongly grounded in a

⁸ “Traditional realists and liberals differ over values, actors, and the dynamics of the system” Stephenson, 1066.

⁹ “[U]nder [constructivist accounts], agents ask “What kind of situation is this?” and “What should I do now?”—with norms helping to supply the answers. Norms therefore constitute states/agents, providing them with understandings of their interests” Checkel, “The Constructive Turn in International Relations Theory,” 326.

¹⁰ “Traditionally, the main competing theoretical perspectives in international relations have been the metatheoretical approaches known as realism and liberalism, but radical and critical perspectives on international relations have always existed along with those” Stephenson, “International Relations, Overview,” 1065.



particular theory.¹¹ Empirical research can sometimes sidestep theoretical quagmires. On many issues there is a high degree of agreement among scholars, even when they identify as members of different theoretical schools. Take, for example, a 2017 survey of international relations scholars which found that a range of researchers often (though not always) agreed about which U.S. policies towards China should be supported or opposed (Figure 1)

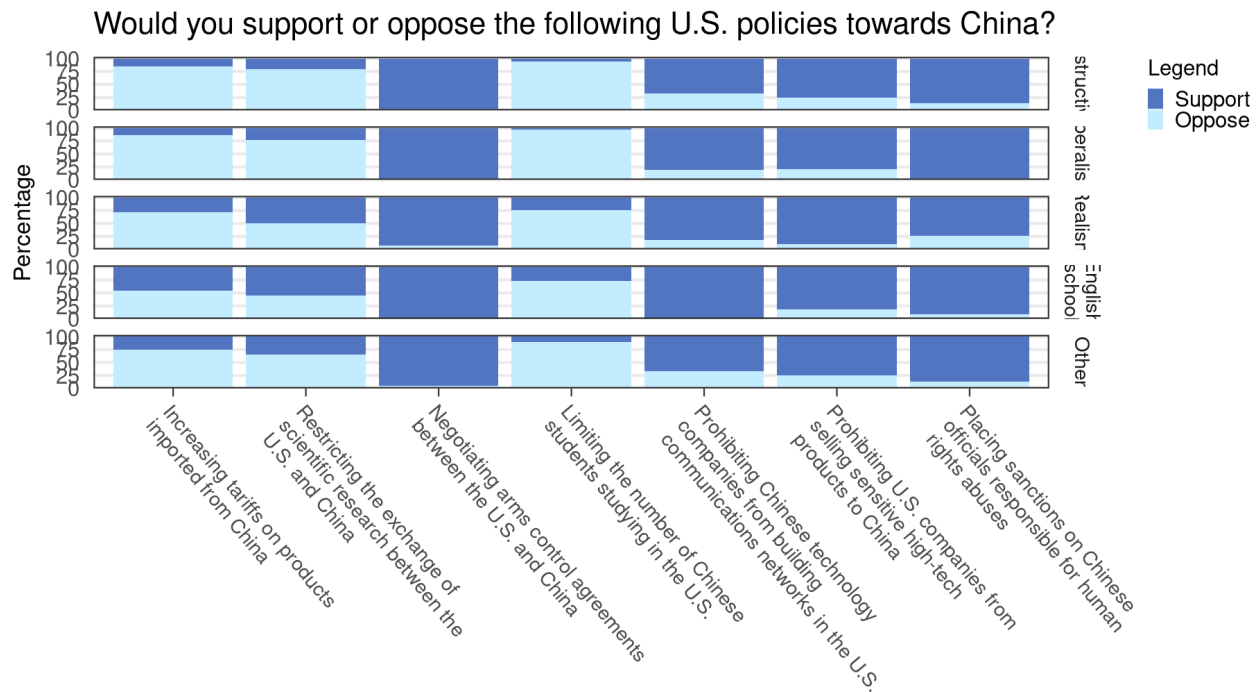


Figure 1: Survey results

Source: Daniel Maliniak et al., "TRIP 2017 Faculty Survey" (Global Research Institute, 2017), <https://trip.wm.edu/>.

For these reasons, in this report we aim to be epistemically modest, to consider a wide range of perspectives, and to tolerate uncertainty. In geopolitical forecasting terms, this is the mindset of a fox as opposed to a hedgehog.¹²

¹¹ This is based on an analysis of articles published in 12 leading IR journals between 1980 and 2007 which found that "most peer-reviewed research does not advance a theoretical argument from one of these theoretical traditions. There is no evidence, moreover, that realism and its focus on power relations among states dominate, or since 1980 ever has dominated, the literature" Daniel Maliniak et al., "International Relations in the US Academy," *International Studies Quarterly* 55, no. 2 (June 2011): 437, <https://doi.org/10.1111/j.1468-2478.2011.00653.x>.

¹² "Foxes draw on many ideas and sources of information; hedgehogs interpret the world using their favorite theory or dogma. Foxes are more tolerant of ambiguity and uncertainty than hedgehogs, who tend to be confident in the rightness of their view of the world" Adrian E. Tschoegl and J. Scott Armstrong,



Irrespective of theoretical tradition, phenomena in international relations can be studied at multiple levels of analysis: individuals, groups, states, pairs of states, and the international system. This will mainly be important when thinking about the causes of war and the variables different interventions aim to affect. A wide range of different actors are also involved in the international system. Although states are probably the most prominent and important of these, researchers increasingly recognize that “[inter-governmental organisations, non-governmental organisations, multinational corporations], and other nonstate actors such as social movements, as well as terrorist networks”¹³ can also have a significant influence. Figure 2 describes these actors and gives examples.

STATES	• EXAMPLES: Brazil, Canada, France, Germany, Poland, Egypt, South Africa, Saudi Arabia, India, Japan, Indonesia, Australia
GREAT POWERS	• EXAMPLES: China, United Kingdom, France, Germany, Japan, Russia, United States
DOMESTIC GROUPS	• EXAMPLES: Political parties, unions, religious groups, business organizations like the Chamber of Commerce
INTERNATIONAL ORGANIZATIONS	• EXAMPLES: United Nations (UN), North Atlantic Treaty Organization (NATO), World Trade Organization (WTO)
MULTINATIONAL CORPORATIONS	• EXAMPLES: Apple, Royal Dutch Shell, JP Morgan Chase, Toyota
TRANSNATIONAL ACTIVISTS and NONGOVERNMENTAL ORGANIZATIONS	• EXAMPLES: Amnesty International, Doctors Without Borders, Bill and Melinda Gates Foundation
INDIVIDUALS	• EXAMPLES: Warren Buffett, Xi Jinping, Angela Merkel, Barack Obama, Vladimir Putin, Mohammed Bin Salman (MBS), Sheryl Sandberg, Donald Trump, Malala Yousafzai

Figure 2: Actors in the IR system

Source: “2.2 Prominent Actors in International Relations,” Pearson Education, accessed May 26, 2021, <https://bit.ly/3FTqPy3>.

“Book Review,” *International Journal of Forecasting* 23, no. 2 (April 2007): 339–42, <https://doi.org/10.1016/j.ijforecast.2007.02.002>.

¹³ Carolyn M. Stephenson, “International Relations, Overview,” in *Encyclopedia of Violence, Peace, & Conflict* (Elsevier, 2008), 1063, <https://doi.org/10.1016/B978-012373985-8.00087-8>.



In this report, we will focus mainly on the actions of states, and in particular, the Great Power states.

Great Power states

Great Power is a useful, if somewhat fuzzy,¹⁴ conceptual category. Great Powers are sometimes defined as countries that have global interests and sufficient power to defend them¹⁵ or as those which influence the dominant “international order”.¹⁶ The political scientist John Mearsheimer uses military capability to identify Great Powers, writing that “to qualify as a great power, a state must have sufficient military assets to put up a serious fight in an all-out conventional war against the most powerful state in the world.”¹⁷ Their military capacity allows Great Powers to compete with their rivals on the battlefield. It also allows them to affect the long-term future in a variety of ways: by facilitating cooperation or inflaming tensions, driving the development of destructive new technologies, or deploying highly-lethal weapons, including weapons of mass destruction.

Which states qualify for Great Power status in the 21st century, the period covered by this report? The size of a country’s military is a key determinant of its power, but not the only factor. The territory it controls and its ability to organize, deploy, manage, and support its military are also important.¹⁸ The multidimensional nature of power means that it is

¹⁴ “While some nations are widely considered to be great powers, there is no definitive list of them. Sometimes the status of great powers is formally recognized in conferences such as the Congress of Vienna or the United Nations Security Council.[1][5][6] Accordingly, the status of great powers has also been formally and informally recognized in forums such as the Group of Seven (G7).” https://en.wikipedia.org/wiki/Great_power#Great_powers_by_date

¹⁵ “[T]he major actors on the international scene have had world-wide interests, as well as the means to protect those interests” Marco Cesa, “Great Powers,” in *An Introduction to International Relations*, ed. Richard Devetak, Anthony Burke, and Jim George, 2nd ed. (Cambridge: Cambridge University Press, 2011), 270, <https://doi.org/10.1017/CBO9781139196598.023>.

¹⁶ “Arguably, the most relevant function performed by the great powers is related to the creation and preservation of some international order” Cesa, 274.

¹⁷ ““Great powers are determined largely on the basis of their relative military capability. To qualify as a great power, a state must have sufficient military assets to put up a serious fight in an all-out conventional war against the most powerful state in the world.6 The candidate need not have the capability to defeat the leading state, but it must have some reasonable prospect of turning the conflict into a war of attrition that leaves the dominant state seriously weakened, even if that dominant state ultimately wins the war. In the nuclear age great powers must have a nuclear deterrent that can survive a nuclear strike against it, as well as formidable conventional forces.” John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: Norton, 2001), 5.

¹⁸ “[I]n assessing the power of any given state at any given time we must look at the space that it occupies and within which it is active, the quantity and the quality of implements and combatants, and finally the organisation of the armed forces, the quality of military and civilian leadership in war and peace, the way in which citizens react to the test of war” Cesa, “Great Powers,” 270.



important to consider economic capability and “questions of political will and the ability to set and alter agendas”, in addition to military strength.¹⁹

By nearly any metric, the US is the world’s most powerful country. The US military spending accounts for 39 percent of the global total in nominal terms.²⁰

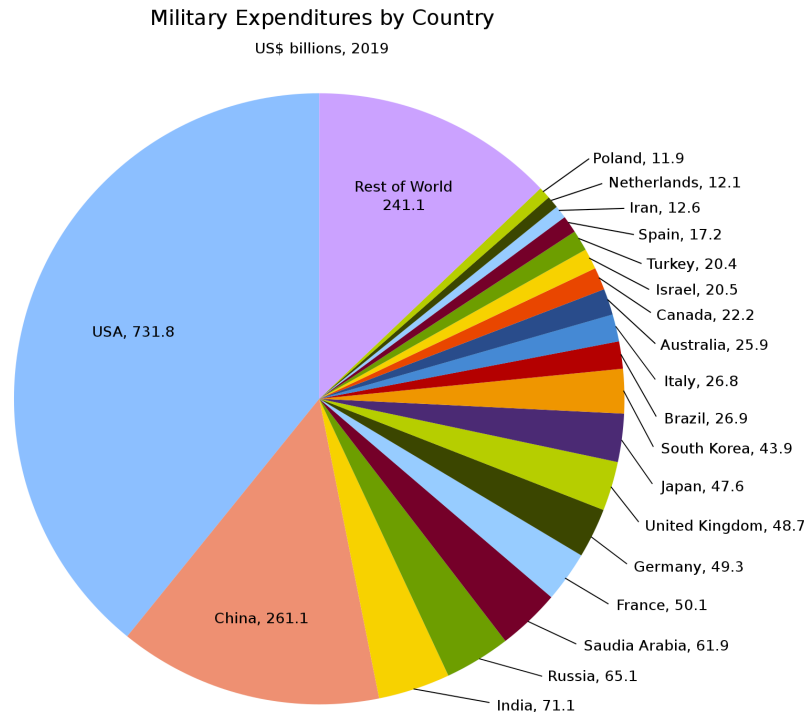


Figure 3: Military expenditures

Source: “List of Countries by Military Expenditures,” in Wikipedia, June 20, 2021, https://en.wikipedia.org/w/index.php?title=List_of_countries_by_military_expenditures&oldid=1029557139.

China is the world’s next most powerful country, accounting for about 13 percent of global military spending. While China’s spending and R&D efforts remain somewhat far behind the

¹⁹ Derek F. Lynch, “Balance of Power Relationships,” in *Encyclopedia of Violence, Peace, & Conflict* (Elsevier, 2008), 156, <https://doi.org/10.1016/B978-012373985-8.00015-5>.

²⁰ Diego Lopes Da Silva, Nan Tian, and Alexandra Marksteiner, “Trends in World Military Expenditure, 2020,” SIPRI Fact Sheet (Stockholm International Peace Research Institute, April 2021), 2.



US,²¹ China's modernizing economy and fast growth rate mean that the American lead is projected to narrow in the future.

Russia is the next most plausible candidate for Great Power status. Its claim rests on the size of its nuclear arsenal.²² Nuclear weapons dramatically alter the military strategies open to a state.²³ Furthermore, the detonation of large numbers of nuclear weapons would cause an unprecedented global catastrophe (we will examine this in more detail in section 4). Russia is also investing in advanced military technologies,²⁴ but can bring to bear only a fraction of the resources of larger economies like China and the US. Russia's military budget is the fourth largest in the world, but comprises just 3.1 percent of the global total.²⁵

²¹ "Notwithstanding these efforts, however, the Chinese arms industry still appears to possess only limited indigenous capabilities for cutting-edge defense R&D [...] Most importantly, no real internal competition exists and the industry lacks sufficiently capable R&D and capacity to develop and produce highly sophisticated conventional arms" Michael Raska, "Strategic Competition for Emerging Military Technologies: Comparative Paths and Patterns," *Prism* 8, no. 3 (January 2020): 70.

²² "In Russian strategic thought, maintaining a variety of sophisticated nuclear weapons can invalidate any conventional advantages of the United States, NATO, and China. Ensuring that Russia remains a nuclear superpower is the basis of all Russian security policies." Raska, 73.

²³ "[H]owever, nuclear weapons may have altered the connection between economic means and military might: if a minor power adopts a strategy based on nuclear deterrence it can easily complicate whatever plans of intimidation a bigger power might have, its modest economic capability notwithstanding" Cesa, "Great Powers," 277.

²⁴ "In October 2012, Russia established the Advanced Research Foundation (ARF)—a counterpart to the U.S. DARPA (Defense Advanced Research Projects Agency). The ARF focuses on R&D of high-risk, high-pay-off technologies in areas that include hypersonic vehicles, artificial intelligence, additive technologies, unmanned underwater vehicles, cognitive technologies, directed energy weapons, and others." Raska, "Strategic Competition," 73.

²⁵ Da Silva, Tian, and Marksteiner, "Trends in World Military Expenditure, 2020," 2.

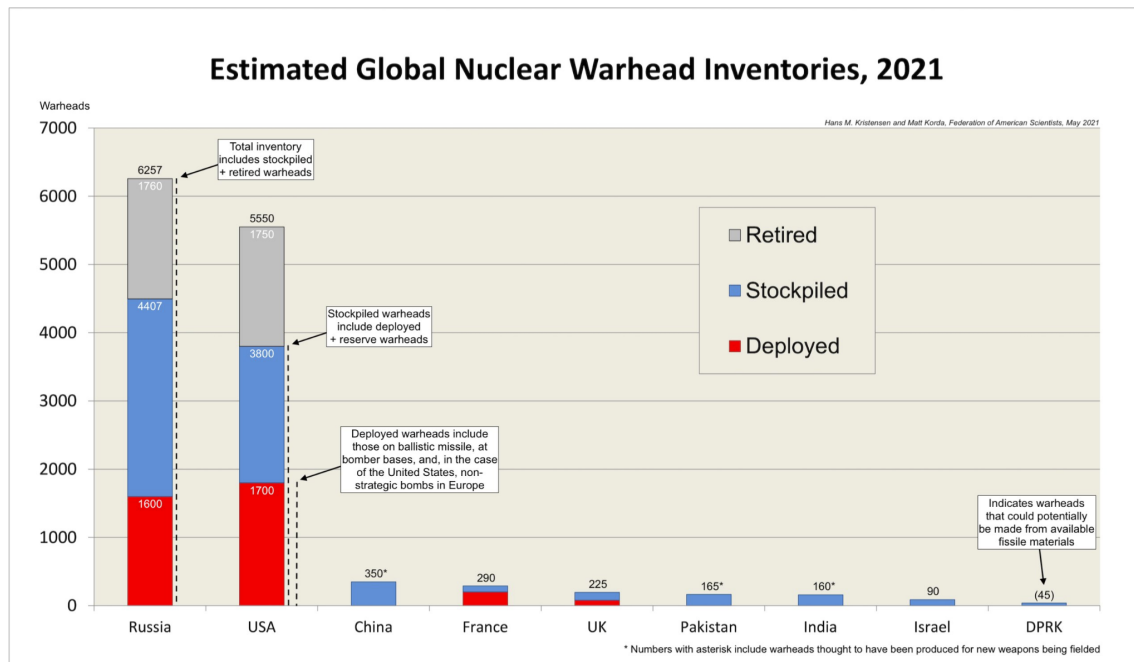


Figure 4: Nuclear warhead inventories

Source: Hans M. Kristensen and Matt Korda, "Status of World Nuclear Forces," *Federation Of American Scientists (blog)*, May 2021,

<https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/>.

Considered together, the states of the EU comprise a political bloc that might claim Great Power status.²⁶ However, a lack of political cohesion likely makes it difficult to project the combined economic and military power of European nations, limiting the EU's claim to Great Power status.

Finally, there are several other countries whose economic size, technology sectors, or nuclear arsenals might give them the ability to affect the long-term future through conflict. The most intriguing of these is India, which has the world's third-largest military budget and about 160 nuclear weapons. India has tense relations with its neighbor Pakistan, which also has about 160 nuclear weapons (but a much smaller military budget). As we will see in later sections, India's economy also has the potential to become the world's second largest this century. For these reasons, we include India in the scope of this report as a 21st century Great Power.

²⁶ "[T]he twenty-seven members of the EU combined constitute the richest area of the planet, the third largest concentration of population and the second biggest military spender. In other words, a politically cohesive EU – something like the 'United States of Europe' – would be a natural candidate for great power status and role" Cesa, "Great Powers," 277.



Table 1. Summary of modern Great Power countries

Country	2020 military budget (% of world share)	Number of nuclear warheads
United States	\$778B (39%)	5600
China	~\$252B (~13%)	350
India	\$72.9B (3.7%)	160
Russia	\$61.7B (3.1%)	6257 (4407 deployed or stockpiled)

Sources:

Diego Lopes Da Silva, Nan Tian, and Alexandra Marksteiner, "Trends in World Military Expenditure, 2020," SIPRI Fact Sheet (Stockholm International Peace Research Institute, April 2021)

Status of World Nuclear Forces. (n.d.). Federation Of American Scientists. Retrieved November 26, 2021, from <https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/>

Other actors

Figure 2 above lists five other types of actors in the international system in addition to states and Great Powers. These are of variable relevance in the rest of the report. For example, individuals can be important as interventions may seek to influence the decisions of certain officials or policymakers by providing them with information.

What causes war?

Having clarified what is meant by terms "Great Power", we now turn our attention to the literature on the causes of war. Great Power war is an intrinsically difficult subject to study. For one, such conflicts are (fortunately) relatively rare: humanity has averaged two major



wars per century for the last 500 years.²⁷ They also have many possible causes. Nevertheless, researchers have made many attempts to tackle this issue and identify factors that increase or decrease the risk of wars breaking out. These are exercises in probability: while factors that guarantee war have not been found, these research efforts have identified many characteristics, contexts, and correlates that make conflicts more or less likely.

Levels of analysis

Many possible causes of war have been proposed. To organize our analysis, we adopt a framework used by both Greg Cashman in *What Causes War* and Jack Levy and William Thompson in *Causes of War*. The possible causes of war are sorted into five categories: the individual level, the sub-state level, the state level, the bilateral level,²⁸ and the system level. Different causes of war apply in different situations, multiple causes might exert an influence in the same situation, and there may be interactions between causes at multiple levels. Both the theoretical reasoning and empirical evidence behind each of these causes are considered.

Rarely does all the evidence point in the same direction; instead, a range of different causes apply to different historical or hypothetical cases. Studies can also produce different, and sometimes contradictory results, depending on how they define and operationalize concepts. Nevertheless, the evidence reviews from Cashman and Levy and Thompson highlight some important findings. In general, territorial disputes, Great Power tensions, ideological conflicts, psychological biases, and escalatory foreign policy responses all seem to raise danger levels. In contrast, the spread of democracy, de-escalation of rivalries, and resolution of minor disputes like competing territorial claims seem to advance peace.

An important caveat for all that follows is that it is difficult to know when findings based on studies of conflicts in the past can be generalized to make predictions about conflicts in the future.

Individual level

Researchers working at the individual level try to explain war by studying the nature and psychology of people, especially the heads of state who decide whether or not to take their

²⁷ “If we look at the record of Great Power wars over the past five centuries (Levy, 1983; Goldstein, 1988, 146), we find an average of about two per century prior to the twentieth century” Bear F. Braumoeller, *Only the Dead: The Persistence of War in the Modern Age* (New York, NY: Oxford University Press, 2019), 26.

²⁸ Cashman calls this the “dyadic” level.



country into war. Many thinkers, from St. Augustine of Hippo to Sigmund Freud, have hypothesized that war results from an innate aggressiveness within humans. However, the empirical evidence for this claim is weak. Though anthropologists, historians, and political scientists debate the roots of violence and warfare, they generally agree that aggression is mediated by the social and environmental contexts in which people live.²⁹ Moreover, attributing the existence of war to innate aggression does little to explain why wars occur some, but not all, of the time.

Researchers have identified several features of state leaders that explain some of the variance in the incidence of warfare. The cognitive revolution of the last several decades, which has emphasized the role of subconscious and emotional processes in individual decision-making, has undermined the idea that rational reasoning alone determines outcomes in international relations.³⁰ Factors that play a role include:

Personality traits: Several studies have presented evidence that leaders with more authoritarian, domineering, extroverted, or risk-tolerant personalities are more likely to advocate for the use of force,³¹ though this literature is too thin to generate any reliable conclusions about the size of this effect.

Heuristics and biases: Leaders use shortcuts and simple models to make decisions, such as relying on historical analogies to assess situations.³² Several experts believe leaders are systematically overconfident when making decisions about war, especially once the war has started or seems inevitable.³³

²⁹ “The views presented here from the perspective of anthropologists, ethnographers, and archaeologists indicate a healthy debate about human violence and warfare. They agree that human violence has existed for millennia, but they disagree about the form it has taken, its extensiveness, and its historical origins. They all agree, however, that violence and warfare have varied depending on environmental and cultural circumstances. Violence is, at least in part, a learned activity, and it is subject to modification” Greg Cashman, *What Causes War? An Introduction to Theories of International Conflict*, Second Edition (Lanham, Maryland: Rowman & Littlefield, 2014), 43.

³⁰ “First, virtually all the theories and concepts discussed in this chapter undermine normal assumptions about the ability of government leaders to make rational decisions. They support the notion that decisions for war or the escalation of conflict are likely to result from nonrational, subconscious, or emotional processes rather than purely logical calculation” Cashman, 112.

³¹ Cashman reviews the relevant literature in the section *The Role of Personality: Psychological Theories*. 52–51.

³² “As Janice Gross Stein notes, political leaders “unconsciously strip the nuances, context and subtleties out of the problems they face in order to build simple frames. When they look to the past to learn about the future, political leaders tend to draw simple one-to-one analogies without qualifying conditions” Cashman, 71.

³³ “Several theorists, Geoffrey Blainey most prominently, suggest that overconfidence on the eve of war is a primary causal factor in the decision for war” Cashman, 98.



Misperception: It is difficult to accurately obtain and process decision-relevant information during times of conflict.³⁴ Given this, leaders may be overconfident in their analyses and predisposed to misperceive their opponents as aggressive yet vulnerable.

Stress: Finally, biases are heightened during times of stress, when people find it even more difficult to reason systematically and clearly. Most, but not all, studies suggest that stress has a significant, negative impact on decision-making ability during times of conflict.³⁵

Since many of these factors, such as personality traits or stress-tolerance, vary among individuals, they can explain some of the variance in the incidence of war. A jingoistic leader alone can make a state more likely to go to war. However, many other factors at levels beyond the individual also bear on this outcome, starting with the influence of group decision-making processes.

Substate level

Decisions to go to war are rarely made by individuals alone: advisors, elected officials, cabinets, and committees are usually also involved. At the sub-state level, researchers focus on how the processes groups use to make decisions affect policy choices. Research questions in this space largely focus on to what degree, and under what conditions, the decisions made by such groups are rational. While wars are costly and risky, it may be the case that the benefits to specific actors sometimes outweigh the costs to those actors. If groups make rational decisions, then they will choose to initiate war in these cases. In reality, though, a number of practical, psychological, and social factors limit the ability of groups to make rational decisions. The need to take shortcuts when making decisions under pressure and political and personal influences on group decision-making processes can cause governments to adopt policies that may not be strictly rational, including going to war when it is costly and risky.

First, groups often only consider a limited number of options. For example, instead of choosing the option that has the highest expected benefits, they may choose a satisficing option: the first option judged to meet some minimum criteria. Or they may be incrementalist and consider only policies that are relatively similar to the status quo. Cashman suggests that case studies of defense decision-making have found evidence of both processes at play.³⁶ During the Vietnam war, incremental policy changes in lieu of

³⁴ “Cashman and Robinson look at seven cases of interstate war in the last 100 years and find that “in almost no case did the leaders in the initiating country, operating under what we have called the fog of prewar, accurately perceive the situation in which they found themselves” Cashman, 215.

³⁵ “While most evidence—from experimental studies or qualitative case studies—suggest the negative effects of stress on decision making, a few studies point in the other direction” Cashman, 111.

³⁶ “Why are such processes employed? Simon and March claim that satisficing and sequential search are devices designed to simplify and expedite the decision process. Executives realize that time is short and



radical rethinks led to ever deeper American military involvement.³⁷ Finally, the organizational process model highlights how, especially in times of crisis, governments are likely to rely on existing plans and standard routines, even if they are not optimized for the current situation.³⁸ At the start of WWI, for example, the German strategy against Russia relied on a pre-existing plan that included invading France, a decision that helped pull Britain into the war against German interests.³⁹

These processes imply that an openness to going to war makes war more likely. If satisficing groups are likely to consider offensive options early, they may find one to be acceptable. Incrementalist groups in situations where the status quo is warlike are unlikely to consider radically different options. And if governments have ready-made plans for war, then the organizational process model suggests they are more likely to be implemented in times of crisis.

Several other studies analyze the organizational and social context in which government decisions are made. The Bureaucratic Politics Model posits that bureaucracies within governments will have different policy preferences and push for policies that offer their unit relative benefits.⁴⁰ For example, one might think that the more influence military

that long decision processes are costly. Furthermore, the perfect solution may never be found. Since it is difficult if not impossible to compare the value of two outcomes, there is no rational process by which the best outcome can be ascertained. Under these circumstances, it is better to seek a solution that is merely acceptable, rather than engage in a drawn-out process that may become a wild goose chase. Anderson's study of the Korean War, Vietnam War, and the Cuban Missile Crisis concludes that American decision makers did not consider each alternative (or each subset of alternatives) before making a final decision; they considered alternatives sequentially, making a yes-no decision about each in turn" Cashman, 122.

³⁷ "The American involvement in Vietnam is frequently depicted as having come about through incremental decisions by several successive administrations. In these analyses, incremental decision making is seen at best as inappropriate and at worst as the source of disaster. Leslie Gelb and Richard Betts, in their iconoclastic *The Irony of Vietnam: The System Worked*, argue that decisions by each administration concerning the American involvement in Vietnam were highly incremental." Cashman, 124.

³⁸ "Governmental subunits function according to standard operating procedures (SOPs)—routines that are devised to deal with immediate problems. This repertoire of contingency plans provides the options available to an organization. If a crisis arises for which there is no contingency plan, decision makers make do with the contingency plans they do have available, even if they were not designed for the current crisis." Cashman, 128.

³⁹ "Jack Levy's review of the pre-World War I crisis suggests that organizational routines—specifically, the war mobilization plans of the great powers—were a major cause (though not the only cause) of that war. The rigidity of these routines made modifying mobilization plans extremely difficult. While this made sense militarily, it was politically disastrous. [...] It would greatly increase the probability that Britain would enter the war, even though German political leaders devoutly hoped to keep Britain neutral. The Germans were unable to change the plan to one that mobilized troops for an offensive in the east, thus ensuring both French and British participation against Germany and a two-front war." Cashman, 130.

⁴⁰ "[The Bureaucratic Politics Model] assumes that governments are not single, rationally calculating units. Instead, they are made up of organizations and individual actors who hold differing opinions about government policy options and who compete with each other to influence decisions" Cashman, 132.



officials are able to exert over policy, the more war-prone a government will be. (Cashman suggests that this is not the case; in fact, the consensus among experts is that military officers are more restrained than their civilian counterparts regarding the use of military force.⁴¹)

Finally, group decision-making may be biased towards risk-taking and polarization relative to individual decisions.⁴² Other analyses have suggested that, under certain conditions, groups are likely to exhibit groupthink (a lack of critical appraisal and tendency towards conformity) which privileges consensus over sound decision-making. Overall, though, empirical evidence for groupthink does not seem conclusive.⁴³

State level

Naturally, many analyses of international politics focus on states as the most important actors.⁴⁴ Research on states has found several observable characteristics that seem to influence how likely a state is to go to war.

An important finding is that larger, more powerful states are more likely to go to war.⁴⁵ One analysis ranked countries from 1620 to 1964 according to an index of power that considered their demographics, economies, and military. At any given time, states ranked in the top five of the list averaged one war per decade. This made them 10 times more likely to go to war than states ranked between 41 and 50.⁴⁶

⁴¹ “As you might have suspected by now, research yields only mixed support for the proposition of “where you stand depends on where you sit.” [...] political scientists have supported the contention that military officers are generally more timid or conservative than their civilian counterparts about recommending the use of military force” Cashman, 137–38.

⁴² “The evidence now suggests the effect of making decisions in groups is to create a tendency toward group polarization” Cashman, 157.

⁴³ “Overall, while several additional cases of groupthink fiascos have been tentatively identified, and many assessments by case studies and laboratory experiments have supported some elements of the groupthink model, we must agree with one set of researchers that there is little support for the complete groupthink model as originally documented by Janis. As Fuller and Aldag conclude, “to our knowledge, no study of groupthink has fully tested the model, and in no study were all results consistent with the model.”” Cashman, 156.

⁴⁴ “Since most international relations scholars see states as the primary actors in international politics, it should come as no surprise that many theorists of international conflict focus on the nature of the state itself, rather than individual leaders or decision-making small groups, as the primary determinant of war.” Cashman, 169.

⁴⁵ “An argument quite frequently made by “realists” is that large, powerful states (regardless of the nature of their political or economic systems) tend to be perpetrators of war rather than small states. A sizable amount of empirical evidence tends to support this thesis” Cashman, 192.

⁴⁶ “Stuart Bremer ranked members of the international system from 1620 to 1964 according to a composite index of demographic, economic, and military power. He discovered what appeared to be a strong linear relationship between power rank and war involvement [...] the states occupying ranks 1–5



Some evidence finds that countries experiencing internal conflict are more likely to get involved in external conflicts.⁴⁷ While there are several possible explanations for this, researchers do not agree on which is most likely. Diversionary war theories, for instance, which suggest that leaders of countries facing internal conflict start external wars as a distraction, are not well-supported.⁴⁸

Other factors that seem like they could be important do not actually seem to have a big impact. The war weariness theory, for example, which predicts that states will be less likely to go to war if they have recently been involved in conflicts, does not have much empirical support.⁴⁹ Similarly, so-called “rogue states,” i.e. countries which eschew international cooperation and may sponsor terrorism or attempt to gain control of weapons of mass destruction, do not actually seem to go to war more often than average.⁵⁰ Neither do capitalist states or countries in economic downturns.⁵¹ Finally, there have been several attempts to link population growth to foreign aggression. The thought is that expanding states seek new territory to provide their growing population with more land and/or resources. Statistical analyses, though, have not found a strong link between population growth and propensity to war.⁵²

averaged war once every ten years while states ranked 41–45 and 46–50 averaged a war once in every one hundred years” Cashman, 192–93.

⁴⁷ “There are some scholars who question whether there is any significant link at all between internal and external conflict [...] However, virtually all these early empirical studies indicating an absence of an internal-external conflict link are subject to strong criticism [...] Later studies using more sophisticated methodology and larger databases have shown much more support for the linkage between internal and external conflict” Cashman, 199–200.

⁴⁸ “Ultimately, it is not entirely clear whether the theory of diversionary wars—applicable to a wide variety of countries and representing a general pattern—has much basis in reality [...] The support for the [theory of diversionary wars] is certainly not very robust. Diversionary war appears to be a distinct path to war, but one that is very little traveled” Cashman, 210.

⁴⁹ “In sum, we must conclude that the evidence supporting the war weariness theory is considerably less than compelling. But we also have some clues as to why the effect of war weariness appears to be negligible: Winning wars appears to create a positive environment in which starting a subsequent war seems more acceptable” Cashman, 235.

⁵⁰ “Since rogues were no more likely to initiate MIDs than non-rogues, their high level of participation in international disputes would appear to be due to the fact that other states direct threatening behaviors at them, perhaps because they are perceived as rogues. [...] Overall, the concept of rogue states does not seem to be very helpful in determining which groups of states are more likely to be involved in international conflict” Cashman, 186.

⁵¹ Some Marxists, for example, hold that capitalist hunger for resources to drive economic expansion makes states more warlike, but the existence of war long precedes the existence of capitalism. Plus, many capitalist states have remained peaceful while socialist states have engaged in imperialism. Similarly, Cashman points out that “wars have broken out in hard times, others have occurred in good times. Neither economic weakness nor prosperity seem to prevent war.” Cashman, 192.

⁵² “Recent research on these theories has been mixed. Stuart Bremer and his associates in the Correlates of War project studied wars involving a sample of European states between 1816 and 1965 and found that neither population density nor changes in population density were associated with participation in war



Bilateral level

The next level of analysis considers relationships between pairs of states. Cashman calls this the dyadic level; here we use the more common term “bilateral” instead. At this level, attention is directed towards how the probability of war breaking out varies as the characteristics of two interacting states change. This is an important level of analysis, as researchers have identified several variables that affect the likelihood of conflict.

First, states that share a border are much more likely to go to war than states that do not. 88 percent of the interstate wars fought between 1816 and 1980 and included in the Correlates of War database were fought between neighboring countries. The only countries that fought wars far from their borders were Great Power countries with imperial global interests.⁵³

Second, the political systems of the states involved in the pairing are significant. In particular, the democratic peace theory, which holds that pairs of democracies are extremely unlikely to fight, is well-supported by multiple strands of evidence.⁵⁴ Pairs of states that include one autocracy and one democracy are more dangerous and it appears that the greater the “political distance” between the states, the higher the danger.⁵⁵

Third, states which have a rivalrous relationship, i.e. states which are of roughly similar power and status and which see each other as threatening, are more likely to fight. The literature suggests that the more equal two countries are in military power, the more likely they are to fight.⁵⁶ One study found that between 1816 and 1965, countries with similar military capabilities were 33% more likely to fight each other than countries with large differences in strength.⁵⁷ The risk of war between rivals also increases as the number of

or initiation of war. As a general rule, population growth does not seem to induce warlike behavior” Cashman, 195.

⁵³ “Most wars are fought by neighbors—contiguous states who share land or water borders. An early inspection of the Correlates of War (COW) data indicated that 88 percent of the sixty seven interstate wars from 1816 to 1980 began as wars between neighbors, and if you delete “imperial wars” involving great powers in their overseas realms, the number is 100 percent” Cashman, 238.

⁵⁴ “All in all, there is enough suspicion that marginal cases of war between democracies have existed to state the dyadic hypothesis in terms of probabilities rather than certainties: Democratic states are extremely unlikely to fight each other” Cashman, 261.

⁵⁵ “Mansfield and Snyder’s study of dyadic relations shows that [...] if the degree of democracy in the most democratic country in the pair is increased by one standard deviation, the predicted probability of war increases from 40 to 65 percent” Cashman, 261.

⁵⁶ “In short, there is considerable robust evidence that static balances of equality or near equality are much more dangerous than balances that tend toward preponderance. There is a general agreement among scholars now on this point, though there is a smattering of evidence on the opposite side” Cashman, 276.

⁵⁷ “The most frequently cited evidence comes from Stuart Bremer’s famous study of “dangerous dyads.” Bremer demonstrates that for all dyads in the international system between 1816 and 1965, war is



hostile interactions grows.⁵⁸ This seems to be both because each hostile interaction, such as a border dispute or military exercise, carries a risk of escalation, and because states respond more negatively as the number of disputes increases.

Rivalries also exacerbate the danger posed by power transitions. Wars (as discussed below) are more likely to break out when the balance of power between two nations is shifting from one to the other.

An important and contentious issue is the effectiveness of deterrence.⁵⁹ Deterrence is the action of trying to persuade an opponent to refrain from taking some action by making the expected costs higher than the perceived benefits.⁶⁰ Advocates claim that by committing to respond harshly to any aggressive actions, states can use deterrence to raise the costs of aggression and make it less likely. The problem is that for rival states with similar capabilities, the logic works both ways: both states may seek to deter the other. This may be part of the reason that war is more likely between states of similar power: if each state feels it can deter the other, each will end up responding to the other's actions with equal or greater shows of force, eventually escalating to full-on war. Such an escalation cycle is known as a conflict spiral. In practice, it seems that states, especially when evenly matched, often act reciprocally. They tend to respond to others' cooperative actions cooperatively, and aggressive actions aggressively.⁶¹

roughly 33 percent more likely for dyads having a small or medium difference in relative capabilities than for dyads with large differences in capabilities" Cashman, 176.

⁵⁸ "Conflicts between rival dyads are not independent phenomena, but are connected; previous disputes increase the chances of future disputes. For instance, Peter Wallensteen reports that 75 percent of all states that become engaged in repeated MID's experience war" Cashman, 253.

⁵⁹ "Although a tremendous amount has been written about the theory of deterrence, relatively little empirical research on conventional deterrence was undertaken until the 1970s. Most of this research has focused on immediate deterrence rather than general deterrence, and more specifically, it has focused on immediate extended deterrence, reflecting one of the central concerns of the U.S. in the Cold War era. The results have been inconclusive and contentious." Cashman, 349.

⁶⁰ "Deterrence, in its broadest sense, means persuading an opponent not to initiate a specific action because the perceived benefits do not justify the estimated costs and risks" John J. Mearsheimer, *Conventional Deterrence*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1983), 14.

⁶¹ "In summary, we can conclude that a large array of scientific studies provide evidence to support a conflict spiral theory of international conflict. Whether it is Soviet-American relations or NATO-WTO interaction, whether it is countries in the Middle East or Asia, similar patterns of interaction have been found. States seem to respond to others in the same manner as they are treated. Cooperation begets cooperation; hostility begets hostility" Cashman, 289.



Wars are also often preceded by arms races between countries,⁶² though it seems difficult to say whether arms races themselves make wars more likely, or if both wars and arms races are made more likely by some other factor (like territorial disputes or conflict spirals).⁶³

A final alternative, or complementary, explanation for why wars occur is that they can result from bargaining failures. Wars are costly in expectation: though some states may emerge from a war as relative winners, the total costs of the war for all participants will exceed the total benefits. Therefore a good explanation for war must explain why states would ever take the risk of going to war rather than negotiate a settlement. An important paper by J.D. Fearon⁶⁴ offered three main categories of explanations for this puzzle: (1) people, including the leaders of states, are sometimes or always irrational; (2) leaders who order war benefit, while soldiers and citizens pay the costs; and/or (3) there are rational reasons to go to war despite risks and costs.

Fearon claims that three rationalist explanations actually hold up. First, “rational leaders may be unable to locate a mutually preferable negotiated settlement due to private information about relative capabilities or resolve and incentives to misrepresent such information”.⁶⁵ Second, “rationally led states may be unable to arrange a settlement that both would prefer to war due to commitment problems, situations in which mutually preferable bargains are unattainable because one or more states would have an incentive to renege on the terms”.⁶⁶ Third, there may be indivisible issues: issues which will not admit compromise.

Alternatively, some researchers feel that cognitive biases and other human behaviours that fall short of rationality are so influential that bargaining theory does not have much explanatory power. As discussed previously, decision makers may just choose actions without weighing costs and benefits accurately.⁶⁷

⁶² “One decisive factor whether a conflict erupts in war is whether it is preceded by an arms race. Michael Wallace found that among 99 cases of ‘serious disputes or military confrontations’ in the period of 1820 to 1964, 23 of the 28 preceded by an arms race ended in war, whereas 68 of the 71 not preceded by an arms race ended without war” Dietrich M Fischer, “Economics of War and Peace, Overview,” in *Encyclopedia of Violence, Peace, & Conflict* (Academic Press, 2008), 664, <https://doi.org/10.1016/B978-012373985-8.00055-6>.

⁶³ “Arms races may be an important factor in the escalation of this action-reaction pattern toward war, although the evidence is less clear on this point” Cashman, *What Causes War?*, 289.

⁶⁴ Fearon, J. D. (1995). Rationalist explanations for war. *International Organization*, 49(3), 379-414.

⁶⁵ James D. Fearon, “Rationalist Explanations for War,” *International Organization* 49, no. 3 (1995): 381.

⁶⁶ Fearon, 381.

⁶⁷ “As [David Lake (in an analysis of the Iraq war)] concludes, “it is hard not to delve into this case without becoming acutely aware of the less than fully rational nature of decisionmaking” Cashman, *What Causes War?*, 335.



International system level

The final level at which the causes of war may be assessed is to view the international system as a whole. Many researchers in the realist tradition, for example, argue that war is caused—or at least enabled—by the absence of a world government. In this international anarchy, there is no global power to enforce rules. As a result, states may fail to cooperate—even when cooperation would leave every state better off—if individual states could gain greater benefits by unilaterally defecting.

At the international system level, attention is drawn to how the military capabilities of different states compare. Realists, for example, generally expect states to be more aggressive when they have a power advantage over their competitors.⁶⁸ States may rationally expect to best their enemies in a war and enjoy the fruits of victory (although why weaker states would fight rather than concede beforehand must still be explained). Another explanation is that because strong militaries allow states to stand up to aggressors and defend themselves, countries will invest heavily in their military. But this investment can appear aggressive to other states, prompting them to also invest more in their military. This tit-for-tat process, known as a security dilemma, can cause states to make large investments in their military capabilities without gaining any security.

This situation is complicated if states can accumulate different types of power. For example, the security dilemma could be mitigated if states can differentiate defensive power from offensive power, or if, due to the types of weapons and tactics available, it is easier to defend than attack.

The possibility that differences in power between states affect how aggressive they are likely to be has spurred the development of multiple theories about the relative stability of different distributions of global military power among states. An international system in which there are multiple powerful states or alliances is known as a multipolar system; a system with two dominant powers is known as bipolar; and one in which one power or alliance is dominant is known as a unipolar system. Some theorists think multipolar systems are more stable as alliances can break and reform to deter aggressors. Other theorists point out that in bipolar systems there are fewer actors and interests to consider, allowing for less complexity when resolving disputes. And unipolar systems have a hegemonic power who can use its military advantage to deter aggression from other states and maintain stability.

⁶⁸ “Realists generally expect strong powers to be aggressors, and the only thing that prevents this is the possibility of defeat” Cashman, 378.



Cashman writes that empirical work has not clearly identified one system orientation as especially stable or dangerous.⁶⁹ Wars have occurred in all different kinds of systems. Moreover, the results of empirical studies are sensitive to how the balance of power is defined and measured. Different attempts to operationalize and analyze system polarity have generated different results; Cashman argues this limits the usefulness of polarity analyses in assessing the likelihood of war, and in fact calls this frame a “theoretical dead end.”⁷⁰

One final possibility is that the probability of war is influenced by changes in the balance of power rather than the existing balance of power itself. Power transition theory suggests that wars are likely to break out when a rising power overtakes a dominant power in military strength. In *Destined For War*, Graham Allison argues that such a conflict is currently brewing between the US and China, and that 12 out of 16 times a state has grown to become the world’s dominant power, it has gone to war with the previous leader.⁷¹ Allison’s work relies on a base rate analysis. There is some leeway for analysts in terms of which transitions and wars are counted for the analysis.

Several other variables also seem important in explaining why some transitions have led to war in the past while others have not. It is notable, for example, that two of the last three dominant power transitions documented by Allison have not led to war. Power transitions are also linked to rivalries, as they by definition involve two states of roughly equal power engaging repeatedly over time. One analysis found that power shifts between pairs of states led to war 14 percent of the time, and 31 percent of the time for rival states (states with a history of disputes prior to the transition).⁷² Nevertheless, the broader literature on power transition theory supports Allison’s general point that international systems undergoing power transitions seem to be especially dangerous. Organski and Kugler, for example, found that between 1860 and 1975, half of the power transitions between rival Great Power countries were followed by a war.⁷³ In fact, that analysis found that power transition was a *necessary* condition for war between Great Power contenders: no such

⁶⁹ “Studies of the polarity [have] produced widely varied and conflicting results” Cashman, 401.

⁷⁰ “Given the differing methodologies used and the divergent results achieved by these research efforts, it is necessary to conclude that the relationship between power distribution and war is far from completely understood. In fact, the attempt to use systemic polarity to explain the onset of war may be a theoretical dead end.” Cashman, 405.

⁷¹ Allison, Graham. *Destined for War: Can America and China Escape Thucydides’s Trap?* Houghton Mifflin Harcourt, 2017

⁷² “Some empirical evidence suggests a relationship between unstable balances of power, rivalry, and war. Wayman discovers that the relationship between power shifts and war is stronger for rivals than nonrivals: While power shifts clearly increases the risk of war between nonrivals, power shifts within rival dyads more than doubles the probability of war (from 14 percent to 31 percent)” Cashman, 256–57.

⁷³ “[Organski and Kugler’s analysis found that] 50 percent of all cases of power transitions led to war” Cashman, 416.



wars occurred without being preceded by a transition.⁷⁴ While Organski and Kugler's results have faced some criticisms, especially regarding the small sample size, they have also been broadly replicated by other analyses,⁷⁵ with others also finding that power transitions led to war about half the time or less.

However, there are also some indications that power transitions may have become less dangerous in recent decades.⁷⁶ Cashman concludes his summary of the evidence on a cautionary note. Several studies have produced contradictory evidence.⁷⁷ And some researchers suggest that, because power transitions are thought to lead to war when the rising and dominant powers are of roughly equal power, power transition theory is just a special form of the established finding that war between equal partners is more likely than war between unequal partners. Despite these caveats, it still seems fair to say that we should pay close attention to power transitions as particularly dangerous times. Given the difficulty of making strong causal inferences in this space, it is difficult to declare that power transitions are either necessary or sufficient for Great Power war. But it does seem to be the case that power transitions create conditions that are known to be dangerous: equality between Great Powers, security dilemmas, and rivalries.

Summary of evidence

From the large literature on war's causes we can draw a few lessons that are highly relevant for making predictions about its future occurrence. First, a rational accounting of the costs and benefits is just one of the variables groups and individuals in charge of states

⁷⁴ "The authors conclude, therefore, that wars among major-power contenders occur only if a power transition is under way" Cashman, 416.

⁷⁵ "Several other studies also lend some support to Organski and Kugler's findings. Stoll and Champion, using the COW composite indicators of relative capability, agree that all of Germany's wars with other great powers occurred when predicted by the power transition theory. [...] Soysa, Oneal, and Park replicate the Houweling and Siccama study using both GDP and the Correlates of War (COW) index of capabilities. With regard to all great powers, their results were similar. [...] Several studies focus on power transitions between enduring rivals. Charles Gochman looked at the conflict involvement of major power and non-major-power rivals from 1816 to 1980.⁴⁸ His analysis generally supports power transition hypotheses." Cashman, 417.

⁷⁶ "One interesting finding [from Soysa, Oneal, and Park] was that if Japan and Germany are included as great powers in the post-World War II period, the results were much weaker: only two of thirteen power transitions since 1945 have resulted in war if Japan and Germany are included. This suggests that power transition theory may be less relevant to the post-1945 period" Cashman, 417.

⁷⁷ "The power transition theory makes intuitive sense; it is consistent with our sense of the probable; it has internal logic; it is fairly parsimonious; and it is linked to important factors at other levels of analysis that also contribute to the initiation of war. Unfortunately, the pile of empirical evidence put forward on its behalf is contradictory. That being said, major shifts in the relative balance between rival states seem to be an important part of the war puzzle. And despite a smattering of findings to the contrary, a significant amount of evidence suggests that we should also have serious doubts about the traditional balance of power hypothesis that equality of power leads to peace. However, the power transition theory itself is probably not the all-purpose, industrial-strength theory that many had hoped for." Cashman, 423.



consider when deciding whether or not to go to war. Psychological biases, personalities, and institutional and social contexts also influence these decisions. Therefore it is fair to say that who is in charge, as well as the social and institutional context in which they work, matter.

Second, while states go to war for many different reasons, two issues are particularly dangerous: territorial disputes between neighboring states and rivalries between Great Powers. One review of the Correlates of War database found that all the wars in the database were fought between neighbors or involved a Great Power.⁷⁸ While Great Power wars are usually rare, they become more likely when a rising power is poised to surpass an existing dominant power. Several analyses have suggested that up to half of such events end in war. This could be because the existing power believes the benefits of remaining the global leader outweighs the costs of war, the rising power seeks to gain dominance to change the existing “world order,” or simply that such situations create a rivalry for status and influence that sparks a conflict spiral. Power transitions probably also make wars more likely because when two countries have similar military capacity, they tend to reciprocate the actions of their rivals. This pattern means that repeated, tense interactions between rivals tend to escalate over time. When states are stuck in a conflict spiral, deterrence policies will tend to increase the risk of war.

In the next section we consider the likely trajectory of our geopolitical situation. By applying this improved understanding of the causes of war to the situation humanity faces in the coming decades, we can suggest how the risk of war is likely to change over time.

⁷⁸ “Most wars are fought by neighbors—contiguous states who share land or water borders. An early inspection of the Correlates of War (COW) data indicated that 88 percent of the sixty seven interstate wars from 1816 to 1980 began as wars between neighbors, and if you delete “imperial wars” involving great powers in their overseas realms, the number is 100 percent” Cashman, 238.



3. Historical trends and future forecasts of Great Power war

We now turn our attention to predictions of future trends in warfare. By understanding the risk Great Power war poses – both in terms of its likelihood and its possible effects – we can better prioritize between working to reduce these risks and working on other problems. Moreover, informed judgments about the nature of these future risks, such as which countries are likely to be involved or which weapons may be used, can aid efforts to evaluate specific interventions.

Forecasting geopolitical trends, especially longer-term ones, is a difficult task. Trends in war and conflict are influenced by a wide range of hard-to-predict factors. These include economic growth rates, domestic political developments, technological change, and international institutions, among others. In the 21st century, we can also expect the world to grow more interconnected, transformative technologies to be developed, and actors other than Great Power states to be empowered.⁷⁹ However, the complexity of the questions at hand should not lead us to dismiss the possibility of making reasoned judgements entirely. Historical base rates and long-term trends can at least give us a hint of what the future is likely to hold. In what follows we use economic projections and trends in weapon development, conflict frequency, and battle deaths to estimate the future risks of war. We compare these predictions to other analyses by experts and forecasters. Overall, we estimate that the likelihood of a Great Power war in the next 100 years is below 50%, but above 10%. Our overall estimate, generated by combining multiple models of the future trend weighted by our subjective credence, is that the risk is about 1 in 3. Recent increases in warmaking capacity and the potential for further innovation in weapons technology mean that such a war, if it breaks out, has the potential to be extremely destructive. That means the risk of war, defined as its likelihood multiplied by the damage it would cause, is very high.

Before moving to estimates of future conflict risk, we review global geopolitical trends in economic growth, military spending, and weapons development to better understand how the geopolitical landscape could evolve in the coming decades. This will prove useful for a few reasons. First, as we saw in the previous section of this report, the risk of war depends

⁷⁹ “Predictions of the future of warfare must be approached with caution. History is full of examples where states have been taken by surprise by novel ideas, sociopolitical changes, or technological breakthroughs. Predicting future trends in the early twenty-first century is particularly problematic as the boundaries between conventional and unconventional, regular and irregular warfare, civilian and military, political and criminal, and public and private are becoming increasingly blurred in many conflict zones” James K. Wither, “Warfare, Trends In,” in *Encyclopedia of Violence, Peace, & Conflict* (Elsevier, 2008), 2431–32, <https://doi.org/10.1016/B978-012373985-8.00198-7>.



on the global balance of power and the political and historical characteristics of the dominant Great Power countries. Second, identifying which countries are likely to lead the world in terms of economic and military capability will help us prioritize which interventions philanthropists should support.

Size and power

The size of a state's economy is not the sole determinant of its military power, but it is a crucial factor.⁸⁰ Larger economies can afford to spend more on their militaries, and in times of war can put many more productive resources towards producing weapons and supporting their armies. Countries with larger economies are also more likely to go to war. Thus it is important to think about which countries are likely to have the largest economies in the coming decades.

GDP projections

It may seem difficult to make accurate long-term GDP projections because a country's growth rate changes over time as it develops and in response to exogenous shocks. However, especially for higher-income countries, economic forecasts based on constant growth rates can be surprisingly accurate.⁸¹ Unfortunately, few researchers seem to have made such projections for the global economy in recent years. The attempt we rely on here is *The Long View*, a report published in 2017 by the consulting firm PwC. *The Long View* attempts to project the state of the world economy in 2050. Its most important assumptions regarding the Great Powers are:

- Growth remains steady at just under 2% in the highest-income countries
- Growth in lower-income countries remains high, but declines slightly
- Russia recovers and grows at around 4-5% between 2021 and 2050

Table 2 shows the assumed growth rate per decade in the PwC report for each of the Great Power countries:

⁸⁰ "Power transition theory broadly recognizes that economic resources are the foundation of military strength and many other forms of power" Andrew B. Kennedy and Darren J. Lim, "The Innovation Imperative: Technology and US–China Rivalry in the Twenty-First Century," *International Affairs* 94, no. 3 (May 1, 2018): 554, <https://doi.org/10.1093/ia/iyy044>.

⁸¹ For example, a projection of US GDP in 2013 made in 1870 by simply assuming an annual growth rate of 1.9% would have been remarkably accurate. See: Frank J. Lysy, "The Rate of Economic Growth and the Budget Gap: Returning to the Long-Term Average Growth Rate Would Eliminate It," *An Economic Sense* (blog), October 15, 2013, <https://aneconomicsense.org/2013/10/15/the-rate-of-economic-growth-and-the-budget-gap-returning-to-the-long-term-average-growth-rate-would-eliminate-it/>.



	Table 2. Assumed average annual growth rate for Great Power countries in PwC report				
	2016-2020	2021-2030	2031-2040	2041-2050	Average
China	8.9	5.0	3.2	3.1	4.5
U.S.	2.0	1.6	1.9	1.9	1.8
India	12.2	7.8	6.9	6.2	7.7
Russia	2.9	4.1	5.1	4.0	4.2

Under these assumptions, the gap between China and the US will grow until about 2030 and then remain largely constant; India will surpass the US, at least in Purchasing Power Parity (PPP) terms and close in on China; the US will decline as a share of the global economy; and Russia will continue to fall behind its rivals.

It is helpful to consider economic projections in both purchasing power and market exchange rate terms. GDP as measured in purchasing power terms measures the size of an economy while adjusting for local prices of goods and services. GDP measured in market exchange rates gives the size of an economy in a common currency (usually US dollars) by simply converting the country's GDP at market exchange rates. Both are relevant here: purchasing power does a better job of conveying relative differences in domestic production capacity, but the market exchange rate measure is relevant for internationally-traded goods. Both domestically- and internationally-produced goods are relevant in military contexts.

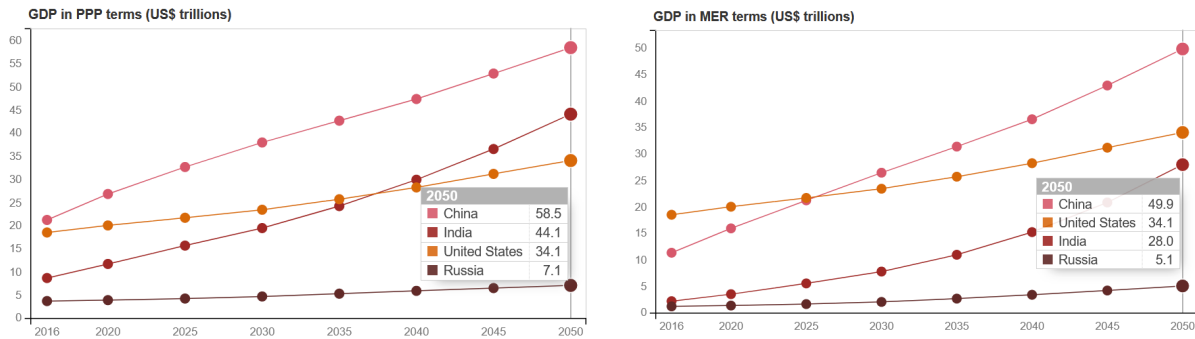


Figure 5: PwC GDP projections to 2050

Source: PwC, February 2017

This report is not an all-things-considered projection of economic growth *in expectation*; it just presents one scenario. It is important to note that this projection could easily end up being wrong in important ways.

One important possibility is that growth could be slower in China and India or faster in the US than the report projects. The report assumes that China and India are able to sustain high growth rates (>3% annually in China and >6% annually in India) for decades. However, few countries have maintained such consistently high growth for that length of time, and both China and India have experienced periods of much lower growth in their past. American growth, meanwhile, is projected to remain relatively low ($\leq 2\%$ annually). But this is below historical average growth in the US and it seems plausible that economic growth in the US could be higher than this. Depending on how much higher or lower the actual growth rates turn out than the report projects, the gap between the Chinese and American economies could be smaller than the PwC report projects.

Another possibility is that the economy could enter a new “growth mode” before 2050, i.e. global growth could dramatically accelerate or decline. One can imagine either of these scenarios. Breakthrough technologies could accelerate economic growth, as they have done in the past.⁸² If transformative AI technologies are developed before 2050 and widely employed throughout the economy, economic growth could speed up dramatically. On the

⁸² “Each represents an alternative history of humanity. Like the real series, the rollouts experience random ups and downs, woven into an overall tendency to rise at a gathering pace. I think of the downs as statistical Black Deaths. The randomness suffices to greatly affect the timing of economic takeoff: one rollout explodes by 3000 BCE while others do not do so even by 5000 CE. In a path that explodes early, I imagine, the wheel was invented a thousand years sooner, and the breakthroughs snowballed from there.” David Roodman, “Modeling the Human Trajectory,” *Open Philanthropy* (blog), June 15, 2020, <https://www.openphilanthropy.org/blog/modeling-human-trajectory>.



other hand, should a disaster like World War III or a pandemic much worse than Covid-19 come about, it's possible that we would see not just a transitory shock but a wholesale slowing of economic growth.

To predict the future distribution of global economic power in expectation, we should put some credence on both of these scenarios. The PwC report does not do so.

Still, the growth assumptions made seem broadly reasonable and aligned with current trends. We put substantial credence on the possibility that actual growth will look broadly similar to the PwC report's projection.⁸³ Even if US growth speeds up somewhat or Chinese or Indian growth falls, the main point here is that, in the most likely future scenario, the US and China continue to be the world's biggest economies, and the gap to India narrows throughout the 21st century.⁸⁴ Figure 6 shows the share of the global economy each economy accounts for in this kind of scenario.

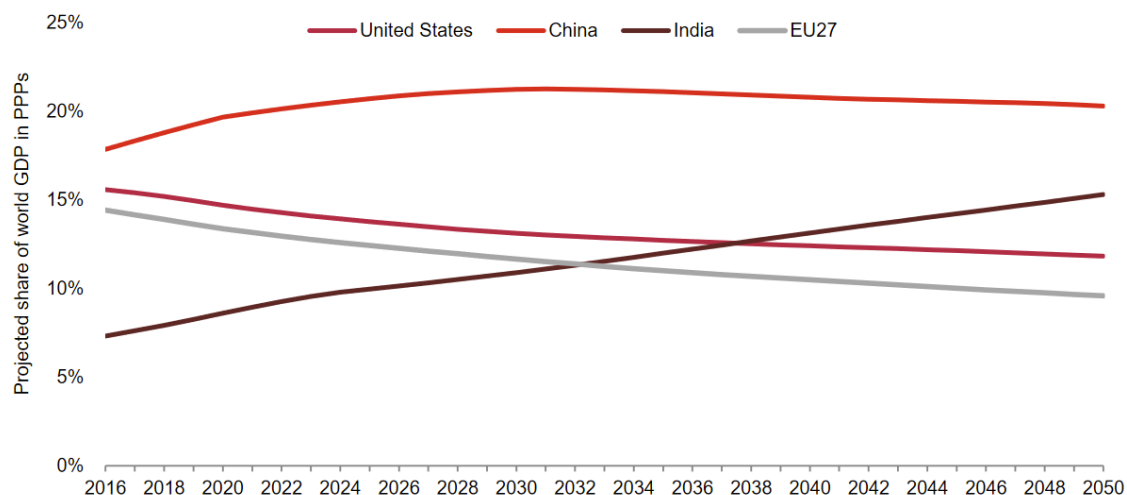


Figure 6: Share of world GDP in PPP terms for 'Big 4' economies

Source: PwC, February 2017

At least in the PwC scenario, China will widen its economic lead over the US, India will surpass the US and approach China, and the economies of these three countries combined will comprise more than half of total global output. However, these three countries are on three different trajectories: China's share of the global economy is expected to peak around 2030 before holding roughly steady, with a slight decline, at around 20% until 2050; India is

⁸³ We have not formally modelled our uncertainty about these projections, but would currently put about 65% of our credence on a view that growth trends for the next 100 years will broadly resemble the trends of the past 100 years (i.e. global growth will not be more than 4 times higher or lower than it has been).

⁸⁴ Of course, all of this is very difficult to assess and we think these credences would shift up or down by up to 50% if we spent another day thinking about them.



expected to grow steadily and increase its share from ~10% today to over 15% by 2050; and the US is in a relative decline, from about 15% of the global total today to just over 10% by 2050 (although in absolute terms the US economy remains large and influential). Russia is not included in the PwC graph. If it were, its share of world GDP would be shown to be much lower, around ~2.5% in 2050.⁸⁵

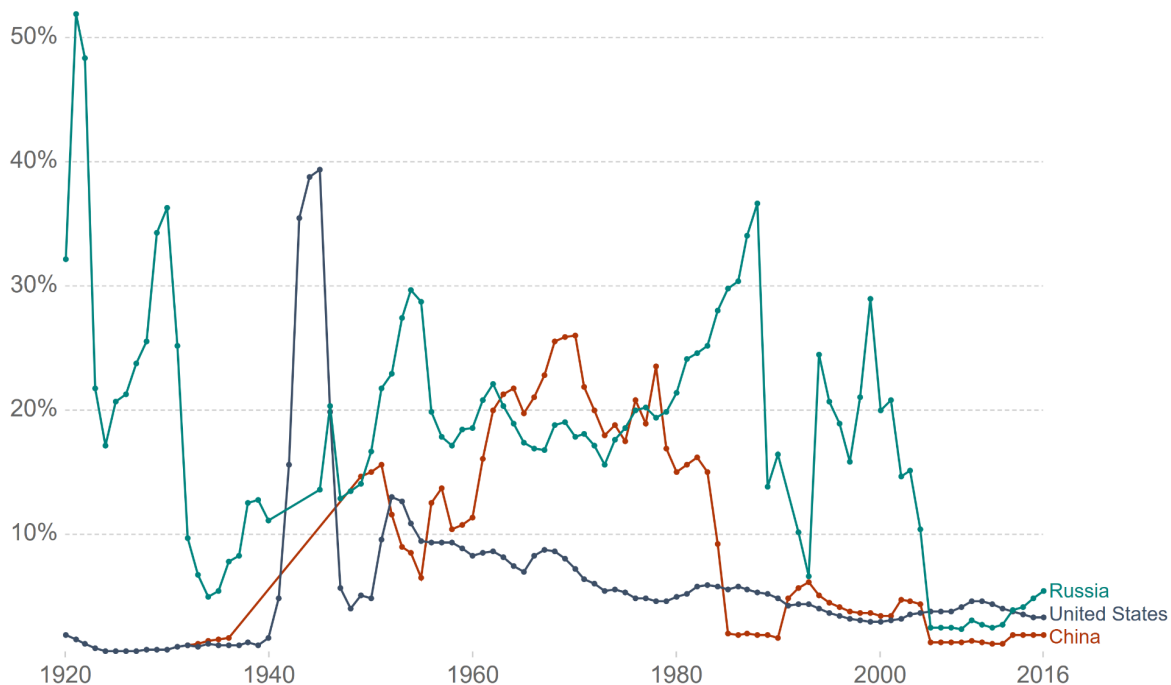
Military spending

Several other factors in addition to economic production also contribute to a state's military strength. Most obviously, a country can choose to devote a greater or smaller proportion of its GDP to military spending. During the Cold War, for example, the Soviet Union consistently spent a larger share of its economic resources on its military than did the US, because the latter's economy was larger. Figure 7 shows that military expenditure as a share of GDP in Great Power countries has varied widely over time.

Military expenditure as a share of GDP, 1920 to 2016

Total military expenditure divided by GDP. Figures correspond to current-prices estimates combining data from several sources.

Our World
in Data



Source: Our World in Data (based on COW & SIPRI 2018)

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⁸⁵ See table 2 on p. 23 of PwC, "The Long View: How Will the Global Economic Order Change by 2050?" (PwC, February 2017), <https://www.pwc.com/gx/en/world-2050/assets/pwc-the-world-in-2050-full-report-feb-2017.pdf#page=68>.



Figure 7: Military expenditure as a share of GDP

Source: Roser and Nagdy, 2013

In an analysis of trends in military spending, Roser and Nagdy identify four key facts.⁸⁶ First, wars have a large effect on how economic resources are allocated. Unsurprisingly, military spending tends to spike when nations are at war. Second, while countries at peace spend less, they still devote a tangible fraction of at least 1% of their GDP to supporting their militaries.⁸⁷ In 2016, for example, Russia spent 5.4% of its GDP on its military, the U.S. spent 3.3%, and China spent 1.9%. Third, the overall trend in military spending is complicated, and may look different depending on which metric is used. Average military spending as a proportion of GDP seems to be falling. However, per capita spending seems to be relatively constant, and since both population and GDP are growing in most countries, absolute military spending is still growing.⁸⁸ Fourth, and similarly, armies are getting smaller on average in per capita terms, but remain at a fairly constant size in absolute terms.

Combining these observations about military spending with the GDP trends, we would predict that, as long as the status quo holds, absolute military spending will grow proportionally with GDP. However, if international tensions were to rise, we might expect Great Powers to devote a larger share of their GDP to military spending, as they have done in the past. This would be concerning: both the American and Chinese economies are much larger than they were in the middle of the 20th century, when military spending as a proportion of GDP in these countries was higher. If military spending were to again take up a larger share of their economies, the absolute level of spending would represent a huge increase in their potential military production.

Summary: Size and power

While geopolitical forecasting is difficult, and we have a high degree of uncertainty about the projections discussed above, some broad lessons about the future balance of power can be drawn. The picture of the 21st century painted by GDP and military spending data is one of increasing economic dominance by the world's largest economies, with large amounts of resources available to be marshalled for military purposes if state leaders deem it necessary.

⁸⁶ Max Roser and Mohamed Nagdy, "Military Spending," *Our World in Data*, August 3, 2013, <https://ourworldindata.org/military-spending>.

⁸⁷ "Indeed, if you switch to the 'map view' in this chart, you will see that vast majority of countries in the world spend at least 1% of GDP in their military." "Roser and Nagdy.

⁸⁸ "Military spending is shrinking relative to national incomes (but in dollars per head there is no clear downward trend)" Roser and Nagdy.



Barring a major disruption or trend change, the US, China, and India are on track to be the world's foremost economies in the 21st century. There will likely be a considerable gap between these three and the next largest country. Even in the absence of full-blown conflict, we should expect absolute military spending to continue to grow. Military spending as a proportion of GDP in China, Russia, and the US is much lower than it was throughout the 20th century. If international tensions were to grow, we could expect to see rapid increases in military spending. History shows that much higher spending levels are possible

Technology and weaponry

Effective militaries need the ability to develop or buy powerful technologies in addition to economic resources.⁸⁹ Technological advancements have had a major influence on how wars are fought in the past, and are poised to do so again in the future. Advances in rifle technology in the early 20th century led to the dominance of trench warfare in World War I, a fundamentally different tactic than those that had been deployed in previous wars. If new military technologies are also more accessible or cheaper, they could also broaden or change the types of actors that are able to participate in destructive wars.⁹⁰ With sufficiently powerful military technologies, smaller states or non-state actors could plausibly pose a global threat.

A striking example of the influence of technological change on warfare is the explosive growth in humanity's total "war-making capacity" as a result of new inventions in the 20th century. Historian Ian Morris has estimated humanity's war-making capacity, which he defines as "the number of fighters they can field, modified by the range and force of their weapons, the mass and speed with which they can deploy them, their defensive power, and their logistical capabilities",⁹¹ throughout history. Morris estimates that, at least in Western nations, war-making capacity increased by a factor of 50 between the years 1900 and 2000. While this is "no more than a guesstimate", Morris seems to think that this ratio is conservative: "a 100:1 ratio [...] might be just as good a guess, although a 25:1 ratio [...] strikes [him] as unlikely."⁹² Morris' estimates of war-making capacity are graphed in Figure 8 below.

⁸⁹ "Emerging technologies such as AI are widely regarded to be a crucial element of future military effectiveness and advantage. In theory (and often in practice), the possession of cutting-edge militarily relevant technologies equals more effective weapons systems, which in turn results in greater military power, which in turn translates into greater geopolitical power" Raska, "Strategic Competition," 66.

⁹⁰ "While interstate conventional wars are likely to remain rare for the foreseeable future, there will still be states and nonstate groups willing to use force to further their political objectives. These actors are likely to continue to employ the techniques of irregular warfare to offset the military advantages of the major powers" Wither, "Warfare, Trends In," 2431.

⁹¹ Ian Morris, *The Measure of Civilization: How Social Development Decides the Fate of Nations* (Princeton: Princeton University Press, 2013), 175.

⁹² Morris, 180.



War-making capacity

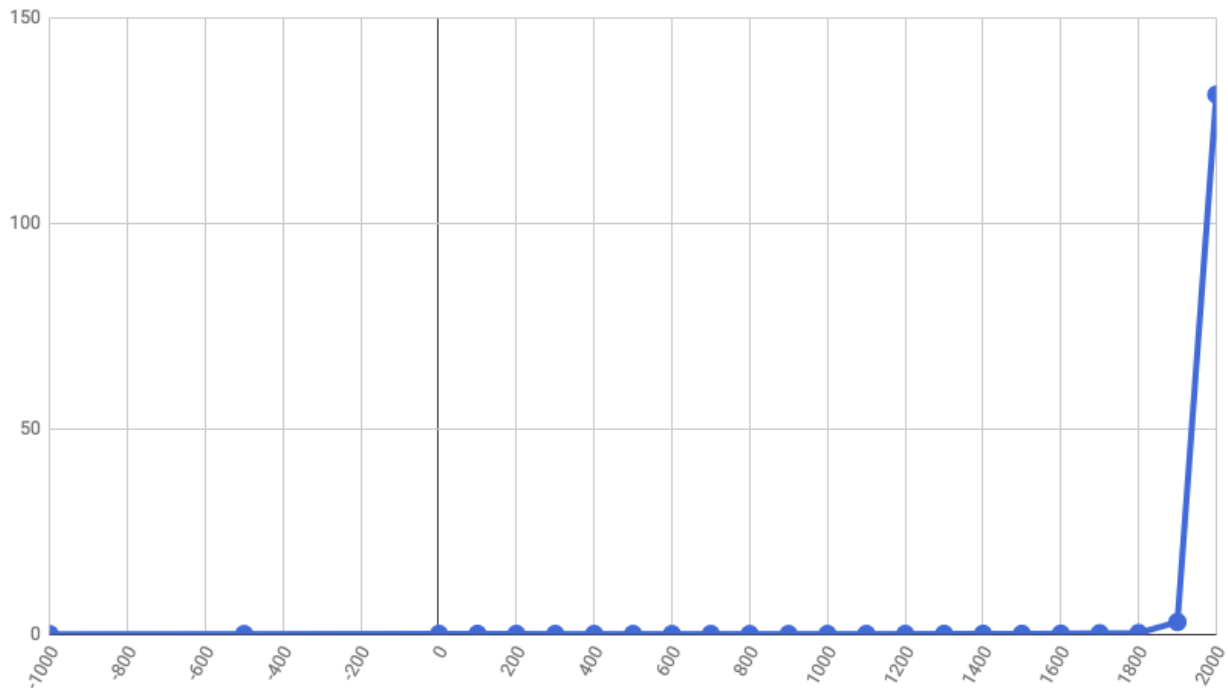


Figure 8: War-making capacity

Source: Luke Muehlhauser, "How Big a Deal Was the Industrial Revolution?," Luke Muehlhauser (blog), n.d., <http://lukemuehlhauser.com/industrial-revolution>.

What will the trend in war-making capacity be in the 21st century? There seem to be two main possibilities. One, the huge 20th century increase in war-making capacity could turn out to be an anomaly. In this case, we might expect war-making capacity to continue to increase, but at a per-century pace somewhere between its 20th century increase and increases in previous centuries.

Alternatively, the 20th century jump in capacity could have resulted from a new growth mode for warmaking capacity. If this were true, we would expect future increases to be as large or larger than the 20th century increases. This would require the invention and mass production of incredibly powerful new technologies. With nuclear weapons alone, a Great Power war could cause extreme destruction on a global scale. Should war-making capacity experience further large increases, the potential for destruction would be enormous.

Which technologies could cause such a change? James Wither lists "robots, directed-energy weapons, genetically engineered clones, and nanotechnology" as



examples of technologies that could “fundamentally alter the character of war”.⁹³ A 2020 Congressional Research Service report on emerging military technologies focuses on artificial intelligence, lethal autonomous weapons, hypersonic weapons, directed energy weapons, biotechnology, and quantum technology.⁹⁴ And new inventions are not the only way to increase war-making capacity. Future technological changes could also make it easier to develop already-existing weapons of mass destruction⁹⁵ or make such weapons more destructive.⁹⁶

In a report from the Center for the Study of Weapons of Mass Destruction, Caves Jr. and Carus write that the development of new kinds of weapons of mass destruction before 2030 is “unlikely”.⁹⁷ They note that several candidates, including weapons utilizing high-powered microwaves or other forms of directed energy, hypersonic kinetic energy, ultra-high explosives and incendiary materials, antimatter, and geophysical manipulation have high military potential but are not close to being developed.

However, this report overall is less than comforting. The authors note that cyber weapons will “probably” be capable of inflicting widespread disruption, requiring investment in countermeasures similar to that required to deter and defend against traditional WMD attacks.⁹⁸ The report also considers a relatively short time horizon, and does not make any

⁹³ “One future scenario is based on emerging technical innovations, which have the potential to fundamentally alter the character of war, such as robots, directed-energy weapons, genetically engineered clones, and nanotechnology” Wither, “Warfare, Trends In,” 2431.

⁹⁴ Kelley M Saylor, “Emerging Military Technologies: Background and Issues for Congress,” CRS Report (Congressional Research Service, November 10, 2020).

⁹⁵ “Technologically, by 2030, there will be lower obstacles to the covert development of nuclear weapons and to the development of more sophisticated nuclear weapons. Chemical and biological weapons (CBW) are likely to be [...] more accessible to both state and nonstate actors due to lower barriers to the acquisition of current and currently emerging CBW technologies” John P. Caves, Jr. and W. Seth Carus, “The Future of Weapons of Mass Destruction: Their Nature and Role in 2030,” Occasional Paper (Washington, DC: Center for the Study of Weapons of Mass Destruction, June 2014), 4, <https://doi.org/10.21236/ADA617232>.

⁹⁶ “Experts consistently opined to us that technological developments pertinent to CBW could be expected to favor the offense over the defense in our timeframe of interest. Our overall conclusion is that it is impossible to predict the specific biological and chemical weapons capabilities that may be available by 2030, but clearly what will be possible will be much greater than today, including in terms of discrimination and the ability to defeat existing defensive countermeasures” Caves, Jr. and Carus, 26.

⁹⁷ Caves, Jr. and Carus, 29.

⁹⁸ “New forms of WMD—beyond chemical, biological, radiological, and nuclear weapons—are unlikely to emerge by 2030, but cyber weapons will probably be capable of inflicting such widespread disruption that the United States may become as reliant on the threat to impose unacceptable costs to deter large-scale cyber attack as it currently is to deter the use of WMD. The definition of weapons of mass destruction will remain uncertain and controversial in 2030, and its value as an analytic category will be increasingly open to question.” John P. Caves, Jr. and W. Seth Carus, “The Future of Weapons of Mass Destruction: Their Nature and Role in 2030,” Occasional Paper (Washington, DC: Center for the Study of Weapons of Mass Destruction, June 2014), 4, <https://doi.org/10.21236/ADA617232>.



predictions about the likelihood of new weapons being invented in the decades following 2030.

Furthermore, predicting specific technological changes is difficult. Leo Szilard famously realized how to design a nuclear chain reaction, an important precursor to inventing nuclear weapons, within twenty-four hours of nuclear physicist and discoverer of the proton Ernest Rutherford having dismissed such an idea as “moonshine.”⁹⁹ Other analyses have shown that expert forecasts on development timelines for technologies like high-level artificial intelligence are highly uncertain.¹⁰⁰ This makes it prudent to put some meaningful probability on the possibility that a currently-unforeseen technology with massive potential for destruction will be developed.

Such a change could happen surprisingly quickly. Consider the extent to which drones have already been integrated into modern military tactics. In the 2020 Nagorno-Karabakh war between Azerbaijan and Armenia, drones provided long-range reconnaissance behind enemy lines, helped aircraft and artillery identify and track targets, and even fired missiles themselves. Their role was described by analysts from the Center for Strategic and International Studies as “game-changing.”¹⁰¹

How much future conflict should we expect?

Now we consider how likely it is that the world’s Great Powers put their large and growing war-making capacity to use on the battlefield in the coming century. We consider long-term trends in the frequency of war and the characteristics of modern day Great Powers to estimate the future likelihood of war. First, we discuss historical trends in the

⁹⁹ “Rutherford had described splitting the atom by bombarding it with protons, but had gone on to say that any suggestion that the energy released might be harnessed as a source of power was “talking moonshine”” “A Point of View: The Man Who Dreamed of the Atom Bomb,” *BBC News*, October 4, 2013, sec. Magazine, <https://www.bbc.com/news/magazine-24395740>.

¹⁰⁰ See, e.g., fig. 1 on p. 730 of Katja Grace et al., “Viewpoint: When Will AI Exceed Human Performance? Evidence from AI Experts,” *Journal of Artificial Intelligence Research* 62 (July 31, 2018): 729–54, <https://doi.org/10.1613/jair.1.11222>.

¹⁰¹ “As numerous recent reports have argued, these weapons were game-changing. Azerbaijani drones provided significant advantages in ISR as well as long-range strike capabilities. They enabled Azerbaijani forces to find, fix, track, and kill targets with precise strikes far beyond the front lines. UAVs were operationally integrated with fires from manned aircraft and land-based artillery but also frequently used their own ordinance to destroy various high-value military assets. Open-source reporting suggests that drones contributed to disabling a huge number of Armenian tanks, fighting vehicles, artillery units, and air defenses. Their penetration of Nagorno-Karabakh’s deep rear also weakened Armenian supply lines and logistics, facilitating later Azerbaijani success in battle.” Shaan Shaikh and Wes Rumbaugh, “The Air and Missile War in Nagorno-Karabakh: Lessons for the Future of Strike and Defense,” Center for Strategic and International Studies, December 8, 2020, <https://www.csis.org/analysis/air-and-missile-war-nagorno-karabakh-lessons-future-strike-and-defense>.



frequency and destructiveness of war. Second, we consider whether the major findings from the causes of war literature suggest the 21st century is likely to be particularly dangerous. Third, we discuss other “all-things-considered” estimates made by experts and other forecasters. Finally, we combine all these considerations to make our own all-things-considered estimates.

Historical trends in war

Whether the risk of war is rising or falling is an important and contentious issue. Some writers on the topic, most notably Steven Pinker in *The Better Angels of Our Nature*, contend that the world is becoming more peaceful overall. Critics claim that the long-term trend in war violence is not clearly negative and that large gaps between wars may be statistical quirks. A particularly contested issue is the nature and the cause of the “Long Peace”, the period of relative stability and peace between Great Powers since the end of World War II. Although the debate between the two sides has often been acrimonious, the broad question is not as intractable as it may seem. Several relevant trends and facts seem supported by the bulk of the evidence. Two things are clear: wars are getting less frequent over time, but more destructive when they do occur. To assess how much risk we face in expectation, we have to consider how these two trends interact.

First: the frequency of war, including Great Power war, has been flat or trending down over time.¹⁰² One analysis has found that Great Power countries today spend a smaller proportion of time fighting each other than they did in the past (Figure 9).

¹⁰² “Virtually all commentators who look at the phenomenon conclude that the empirical evidence is fairly clear: Interstate wars are declining” Cashman, *What Causes War?*, 488.



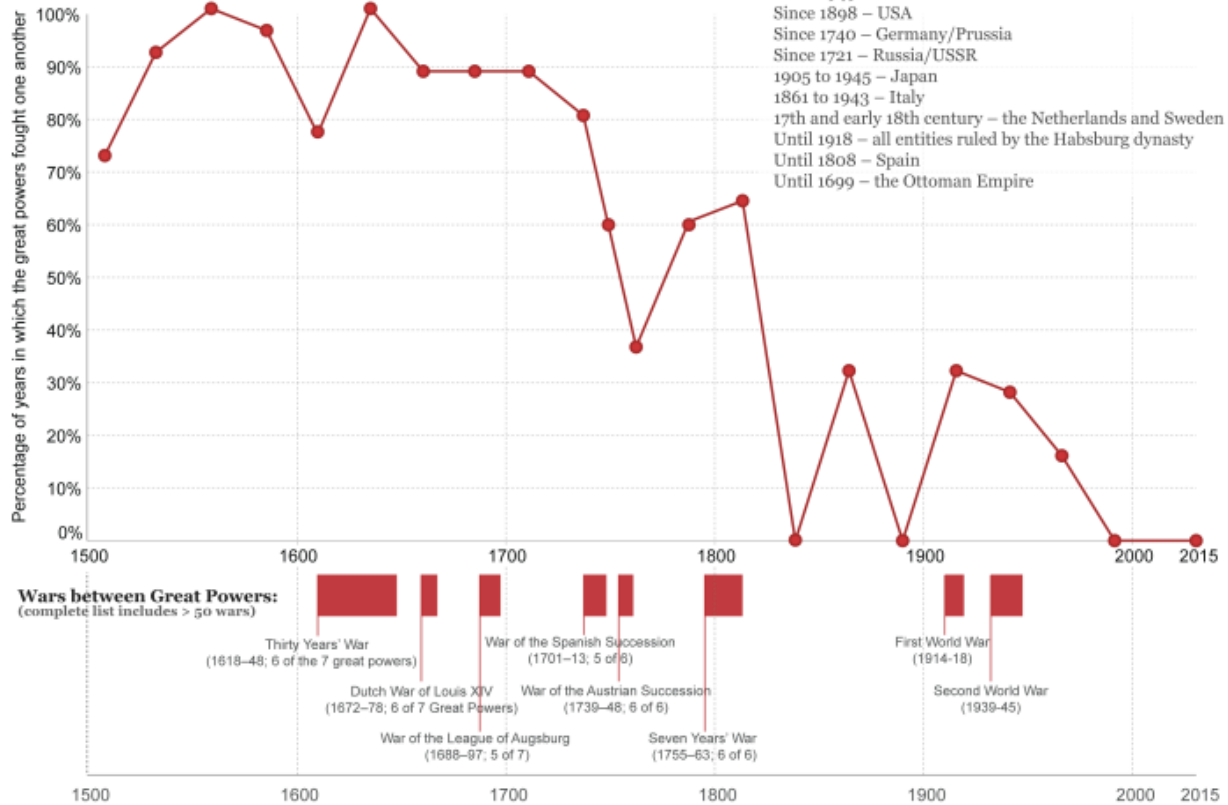
Our World
in Data

Percentage of years in which the 'Great Powers' fought one another, 1500-2015 – by Max Roser

Between 1500 and today there were more than 50 wars between 'Great Powers'.
Data are aggregated over 25-year periods.

The Great Powers:

Entire period – France and England/Great Britain/U.K.
Since 1949 – China
Since 1898 – USA
Since 1740 – Germany/Prussia
Since 1721 – Russia/USSR
1905 to 1945 – Japan
1861 to 1943 – Italy
17th and early 18th century – the Netherlands and Sweden
Until 1918 – all entities ruled by the Habsburg dynasty
Until 1808 – Spain
Until 1699 – the Ottoman Empire



Data source: Steven Pinker (2011) – *The Better Angels of Our Nature: Why Violence Has Declined*. Based on data from Levy, J. S., & Thompson, W. R. (2011) – *The Arc of War*.
The interactive data visualisation is available at [OurWorldInData.org](https://ourworldindata.org/war-and-peace). There you find the raw data and more visualisations on this topic. Licensed under CC-BY-SA by the author Max Roser.

Figure 9: Frequency of Great Power fighting

Source: Max Roser. (2016). "War and Peace". *OurWorldInData.org*. Retrieved from <https://ourworldindata.org/war-and-peace>

However, other analyses have failed to find a clear trend in the frequency of conflict. In an extensive analysis of long-term trends in war, International Relations scholar Bear Braumoeller finds no evidence to suggest that wars of all kinds are becoming less common.¹⁰³ Note that this does leave open the possibility that Great Power wars specifically are becoming less common.

¹⁰³ "[N]othing in the data gives me much reason to sustain [the hope that the world is becoming more peaceful]. The rate at which countries use force against one another has increased more than it has decreased over the last two hundred years. The decrease following the end of the Cold War, while real, is the exception rather than the rule" (Braumoeller, Bear F. *Only the dead: the persistence of war in the modern age*. Oxford University Press, 2019, p. 99)



Second: wars have been getting more deadly over time. Far more people were killed in World War I and World War II than had been killed in any previous war. Some evidence suggests that even after adjusting for population growth, the death rate from atrocities like major wars is growing over time. In a GiveWell blog post, Holden Karnofsky used data from Matthew White's *Atrocities: The 100 Deadliest Episodes in Human History* to estimate the annual death rate from large, violent events for the last 25 centuries. His results, shown in Figure 10 below, suggest that the death rate from major atrocities is increasing over time.

Deaths from atrocities per 100k people per year vs. Century

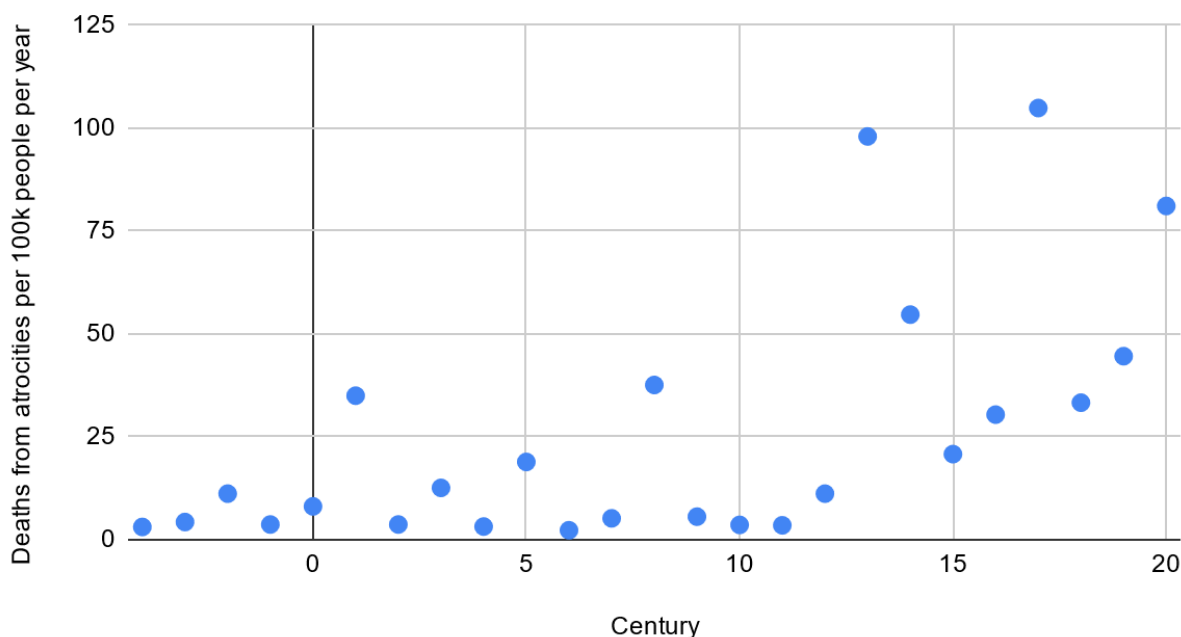


Figure 10: Deaths from atrocities

Source: Data from Holden Karnofsky, "Has Violence Declined, When Large-Scale Atrocities Are Systematically Included?," GiveWell (blog), July 8, 2015,

<https://blog.givewell.org/2015/07/08/has-violence-declined-when-large-scale-atrocities-are-systematically-included/>.

This analysis comes with some caveats. First, Figure 10 is not a graph of the overall violent death rate. It does not take into account murders, for example, which have declined over time.¹⁰⁴ Second, this dataset includes many events other than Great Power wars, like the fall of the Western Roman Empire in the 4th and 5th centuries and the Atlantic Slave Trade

¹⁰⁴ Max Roser and Hannah Ritchie, "Homicides," Our World in Data, July 6, 2013, <https://ourworldindata.org/homicides>.



in the 16th. Third, estimates of the death toll from past atrocities are highly uncertain, especially for early centuries.¹⁰⁵ There may also be undocumented events. While it seems unlikely that any major atrocities are missing, it is plausible that many events with somewhat smaller death tolls are missing. However, since the death rate for the 20th century is influenced by the two World Wars (which account for about 50% of the total), limiting the analysis to Great Power wars would likely lower the data points for earlier centuries more than it would for the 20th century, and the trend would appear stronger.

So the expected death rate from major conflicts is plausibly shaped by two opposing trends. There are plausibly fewer Great Power wars over time, but the wars that do occur are becoming much more deadly. How these trends balance out is the crux of the debate between conflict optimists and conflict pessimists. Each side offers a competing explanation for one of the most important phenomena in conflict studies: the “Long Peace”, a lack of conflict between Great Powers since World War II.

The Long Peace

Over the last 75 years, the death rate from conflicts between states has fallen to almost zero (Figure 11) and combatants from Great Power nations have come into direct conflict only once.¹⁰⁶

¹⁰⁵ “[Better Angels of Our Nature] used a figure of 36 million for the An Lushan rebellion in the 8th century, but Matthew White has since revised his estimate to 13 million. With that revision, the 8th century doesn’t look especially violent compared to later centuries; without it, it would look like the bloodiest century of them all. In my view, this highlights how fragile these figures are, especially for earlier centuries” Holden Karnofsky, “Has Violence Declined, When Large-Scale Atrocities Are Systematically Included?,” *GiveWell* (blog), July 8, 2015, <https://blog.givewell.org/2015/07/08/has-violence-declined-when-large-scale-atrocities-are-systematically-included/>.

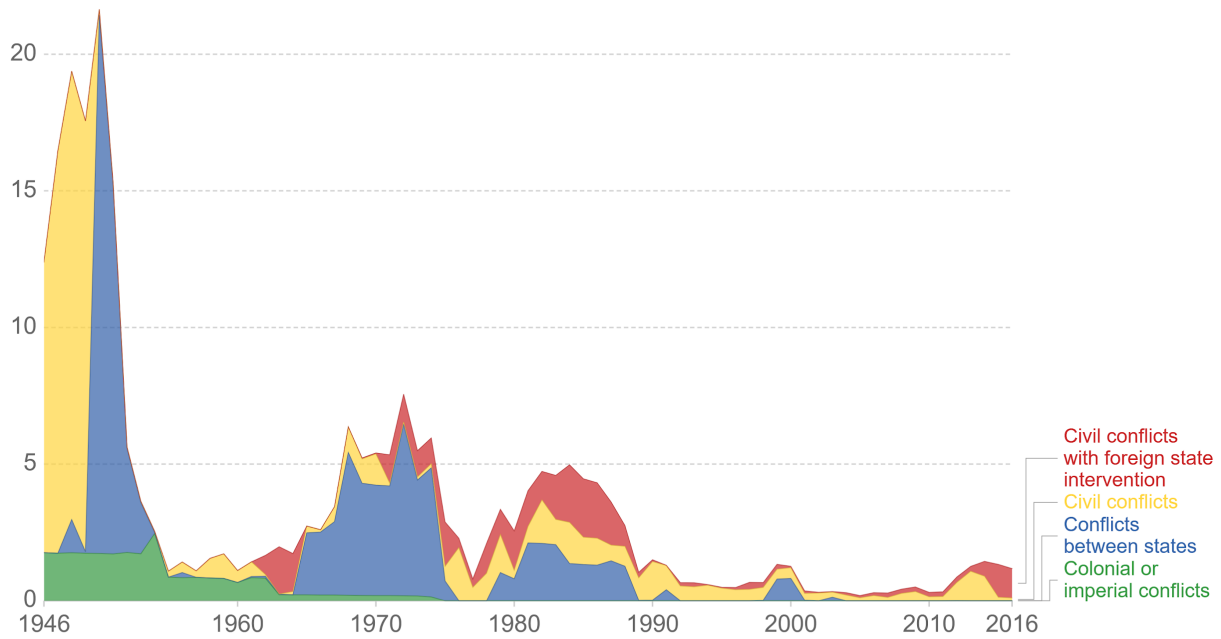
¹⁰⁶ “Of the roughly thirty-seven interstate wars from 1945 to 2007, only one (Korea) involved forces of the great powers arrayed against each other” Cashman, *What Causes War?*, 193.



State-based battle-related deaths per 100,000 since 1946, 1946 to 2016

Only conflicts in which at least one party was the government of a state and which generated more than 25 battle-related deaths are included. The data refer to direct violent deaths per 100,000 of world population. Deaths due to disease or famine caused by conflict are excluded. Extra-judicial killings in custody are also excluded.

Our World
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Source: UCDP/PRIO

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Note: The war categories paraphrase UCDP/PRIO's technical definitions of 'Extrasystemic', 'Internal', 'Internationalised internal' and 'Interstate' respectively. In a small number of cases where wars were ascribed more than one type, deaths have been apportioned evenly to each type.

Figure 11: Battle deaths per 100,000 population

Source: Max Roser, "War and Peace," Our World in Data, December 13, 2016,

<https://ourworldindata.org/war-and-peace>.

One possible explanation for the Long Peace is that the decline in the frequency of Great Power wars has reached its endpoint, and that such wars simply do not happen anymore. In *The Better Angels of Our Nature*, Stephen Pinker considers four theories that try to explain the sudden drop in war after 1945.

First, he asks if the Long Peace is a nuclear peace, brought about because nuclear war is "too dangerous to contemplate"¹⁰⁷ The timelines here line up nicely. The Long Peace appears to have started suddenly in 1945, when Great Power conflict dropped significantly. This is directly after nuclear weapons were first used in warfare. Additionally, some empirical work has found that while crises and militarized disputes still occur between nuclear-armed states, they are less likely to escalate to all-out war than are disputes

¹⁰⁷ Steven Pinker, *The Better Angels of Our Nature: A History of Violence and Humanity* (London: Penguin, 2012), 323.



between non-nuclear-armed states.¹⁰⁸ However, the existence of nuclear weapons alone may not be a powerful enough explanation for the Long Peace. Many non-nuclear armed states have also experienced an extended period of peace since WWII. In addition, some non-nuclear states did challenge nuclear-armed states, as in Korea, Vietnam, and Afghanistan, in the 20th century.

If the reluctance of states to use nuclear weapons is not due to the risk of retaliation alone, why have no nukes been used in a war since WWII? A compelling explanation is that the use of such weapons has become taboo.¹⁰⁹ Much like other weapons of mass destruction, the development and use of nuclear weapons has been constrained and even criminalized by multiple international treaties. Nuclear weapons have remained in their silos not for lack of opportunity to deploy them. In fact, military officials drew up “contingency plans” for their possible use in Vietnam. But using such weapons would cross a moral red line. It was so unthinkable—and politically toxic—that Lyndon B. Johnson shut down the plans as soon as he became aware of them.¹¹⁰ It seems that very high barriers to the use of nuclear weapons have been erected, but these barriers cannot explain why war itself has become less likely.

The second theory Pinker considers is whether the Long Peace can be explained by the spread of democracy. As we have seen, the strength of democratic peace theory has been well-established by researchers. And it is true that the number of democracies in the world grew dramatically following WWII, rising from about 20 after the war ended to more than 90 in 2010.¹¹¹ But between 1945 and 1989, the world’s second most-powerful country, the Soviet Union, was not democratic. Neither were about 100 other countries in the world. So

¹⁰⁸ “We have empirical evidence from a number of studies that indicate that, compared with other pairs of states, dyads consisting of two nuclear weapons states (symmetrical dyads) are less likely to be involved in MIDs that escalate to full-scale war and that such dyads are less likely to be involved in crises that end in violence [...] While the statistical probability of war is comparatively low for nuclear dyads, it would appear that joint possession of nuclear weapons does not prevent nuclear states from becoming involved in crises or militarized disputes with each other.” Cashman, *What Causes War?*, 362–63.

¹⁰⁹ “Nuclear weapons don’t build themselves [...] But this activity has been compartmentalized into a sphere of hypotheticals [...] And there are telltale signs that the psychology of taboo—a mutual understanding that certain thoughts are evil to think—has been engaged” Pinker, *The Better Angels of Our Nature*, 325.

¹¹⁰ “By the mid-2000s, Nina Tannenwald and documents declassified by the State Department had already revealed that Johnson shut down the military’s 1968 contingency planning for the employment of tactical nuclear weapons in the Vietnam war. The most recently declassified documents, however, convey just how far this planning had advanced at Pacific Command before press disclosures in Washington brought the full scope and scale of Fracture Jaw to the attention of a furious president and a beleaguered White House.” Theo Milonopoulos, “How Close Did the United States Actually Get to Using Nuclear Weapons in Vietnam in 1968?,” *War on the Rocks*, October 24, 2018, <https://warontherocks.com/2018/10/how-close-did-the-united-states-actually-get-to-using-nuclear-weapons-in-vietnam-in-1968/>.

¹¹¹ See figure 5-23 in Pinker, *The Better Angels of Our Nature*, 336.



while the spread of democracy, especially in Western Europe, is probably an important part of the puzzle, it does not fully explain the Long Peace.

Third, Pinker asks whether a more general form of democratic peace theory, which he calls liberal peace theory, explains the Long Peace. Perhaps the spread of political and economic freedom, as well as international trade, encourages peace. Some studies support the idea that the more trade there is between two countries, the less likely they are to clash.^{112,113} There is some empirical support for this idea, but the evidence is not conclusive. Critics suggest that the benefits of trade are small relative to diplomatic concerns, and that states are more concerned with relative gains than absolute gains.¹¹⁴

Finally, could the Long Peace be the result of changing international norms to punish conflict and encourage cooperation?¹¹⁵ Pinker suggests that such a process, sparked by the proliferation of intergovernmental organizations and attendant increase in flows of people, money, goods, and ideas, could be making the idea of going to war “inherently immoral”.¹¹⁶ He cites empirical evidence that countries which both belong to intergovernmental organizations are more peaceful.¹¹⁷

Overall, none of the four theories Pinker suggests may be strong enough to explain the Long Peace on its own. It does seem likely that all four factors have contributed to making peace more common. For example, in Europe the spread of democracy and growing economic connectedness seem like strong explanations for the prevalence of peace in a region that was, for most of history, very unstable. But at a global scale, many ideological conflicts and competing interests remain entrenched.

¹¹² “[Russett and Oneal] found that countries that depended more on trade in a given year were less likely to have a militarized dispute in the subsequent year” Pinker, 345.

¹¹³ “Most states have benefited from the growth of trade and attendant prosperity arising from globalization. [Economic interdependence] makes it harder for states to act independently or pursue unilateral, selfish state interests with impunity” Wither, “Warfare, Trends In,” 2426.

¹¹⁴ “Many find that trade is associated with peace (Polachek 1980, Oneal & Russett 1997), the relationship is modest in strength and is sensitive to measurement techniques and time periods analyzed. Some find that trade is associated with conflict (Barbieri 1996)” Jack S. Levy, “The Causes of War and the Conditions of Peace,” *Annual Review of Political Science* 1, no. 1 (June 1998): 150, <https://doi.org/10.1146/annurev.polisci.1.1.139>.

¹¹⁵ “The spread of global norms undermining the legitimacy of the use of interstate war is part of a more general process in normative change at the global level” Cashman, *What Causes War?*, 489.

¹¹⁶ Pinker, *The Better Angels of Our Nature*, 351.

¹¹⁷ “Russett and Oneal counted the number of IGOs that every pair of nations jointly belonged to, and they threw it into the regression analysis [...] The researchers concluded that [...] democracy favors peace, trade favors peace, and membership in international organizations favors peace” Pinker, 349.



Will the Long Peace last?

Has humanity turned a corner on war, or will we look back on this time as merely an extended gap between Great Power conflicts? Conflict optimists claim that peace has prevailed since WWII due to durable changes in how states interact with each other economically, socially and politically. This would imply that peace is here to stay so long as these modes of interaction do not change again. Opponents focus on reasons to think that humanity's good fortune may not hold in the decades to come. Their arguments center on the idea that, in the context of human history, 75 years of peace is not so long after all. Given uncertainty about the future geopolitical, social, and diplomatic context, we place much more weight on the historical baseline, in which Great Powers have often gone to war.¹¹⁸

Some researchers have written that the Long Peace is consistent with a historical, statistical pattern of war deaths that does not show a decline over time. Deaths in war follow a power law distribution. Most wars involve relatively few casualties, but extreme events with casualties several orders of magnitude higher than the average are also observed. Crucially, such events are quite rare. One analysis by Cirillo and Taleb found that the average time between wars with more than 10 million casualties is more than 130 years (though this falls to about 50 years when they rescale data from past wars to account for a smaller world population) (Figure 12).¹¹⁹ They argue that this means that the duration of the Long Peace alone is not strong evidence of a lasting decline in violence.¹²⁰

¹¹⁸ "The world is vast, eighty years is a long time, and the number of possible global social & diplomatic scenarios over such period [sic] is vast. So it seems crazy to base predictions on future war rates on inside view calculations from particular current stances, deals, or inclinations. The raw historical record, and its large long-term fluctuations, should weigh heavily on our minds" Robin Hanson, "Big War Remains Possible," *Overcoming Bias* (blog), July 25, 2019, <https://www.overcomingbias.com/2019/07/big-war-remains-possible.html>.

¹¹⁹ See Table II. Cirillo and Taleb, "On the Statistical Properties and Tail Risk of Violent Conflicts." *Tail Risk Working Papers*. <https://arxiv.org/pdf/1505.04722.pdf>

¹²⁰ "Largely, the paper argues that the historical data do not appear improbable if we assume no trend over 2,000 years in war deaths. That is, the data are consistent with no trend" David Roodman, "More Violence," *David Roodman* (blog), May 28, 2015, <https://davidroodman.com/blog/2015/05/28/more-violence/>.

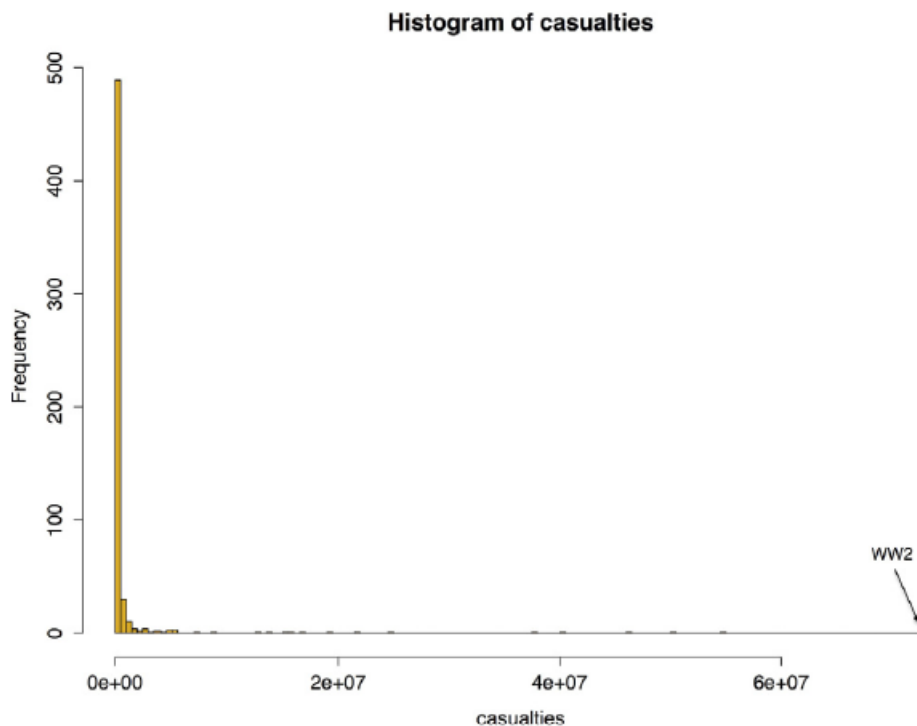


Fig. 3. Histogram of war casualties, using raw data. A long fat right tail is clearly visible.

Figure 12: Distribution of war casualties

Source: Pasquale Cirillo and Nassim Nicholas Taleb, "On the Statistical Properties and Tail Risk of Violent Conflicts," *Physica A: Statistical Mechanics and Its Applications* 452 (June 2016): 35, <https://doi.org/10.1016/j.physa.2016.01.050>.

Another factor that may support the pessimist's perspective is the frequency of close calls during the Cold War during which a Great Power conflict seems to have been on the verge of breaking out. The Cuban Missile Crisis is the highest profile, but not the only, example. In fact, up to 19 disputes that occurred between 1947 and 1991 could be considered close calls.¹²¹ That means there was one incident every two or three years on average. These close calls fall into 5 categories: early-warning system failures (8 instances), incursions in a power's neighborhood or region (5 instances), proxy war escalations (3 instances), diplomatic crises (2 instances), and one instance of an individual ordering a nuclear first strike.

In most, or perhaps all, of these cases, an escalation to all-out war was probably unlikely. There could be robust fail-safe measures that mean these close calls are systematically

¹²¹ We have compiled a database of close calls [here](#).



stopped before escalating to full-blown war. The fact that no such early warnings have ever escalated to nuclear war may be taken as a sign that relatively robust fail-safe measures exist and work well.¹²² But in several cases, the decision about whether to escalate in response to a perceived threat seems to have come down to individual decision-makers. The three instances of regional incursions seem most alarming, as territorial disputes have been a common conflict issue over time. If each of these events had a small, but non-negligible, probability of escalating to full-blown war, then it is possible that the U.S. and USSR escaping the Cold War without direct conflict was the result of good luck in addition to, or instead of, good decision-making.

One issue with Cirillo and Taleb's analysis is that they do not specifically test for a change in the frequency of war after 1945. Since proponents claim that many of the plausible causes of the Long Peace came into force after this date, they may also claim that the long-term trend analysis does not directly challenge the theory. It may be that the last 70 years of peace have not been long enough to influence the 2000-year trend, but have nevertheless been especially peaceful for enduring reasons. In other words, the Long Peace is consistent with multiple statistical models. Pessimists can champion a statistical model where the risk of war is constant, but there can be long lags between conflicts. Optimists may argue that the risk of war was constant or changing slowly for centuries, but then changed quickly after 1945 for some of the reasons explained above. Since the underlying social, economic, and political processes that generate conflicts cannot be observed, other arguments must be considered to decide which statistical model is more plausible.

All things considered, the confluence of the Long Peace, nuclear deterrence, and spread of liberal norms, institutions, and trade seems unlikely to be a statistical quirk. In other words, the Long Peace was probably more than just good luck. When Cirillo and Taleb rescale the death toll of wars to account for world population, a 75 year gap between conflicts killing more than 10 million people (adjusted for world population) is longer than the historical average, albeit still within one mean absolute deviation.

To estimate the likelihood of future conflict, however, we must ask whether these peaceful conditions will last, and for how long. Several possibilities seem troubling. First, new

¹²² 'It's difficult to know for sure, but I'm struck by the fact that a number of the close calls caused by accidents reported by Baum et al. (2018) have similar-sounding endings — usually something like "because there was no other evidence of an attack..." X agency "determined it was a false alarm caused by" X malfunction (Baum et al., 2018, p. 30). This could be interpreted to mean that, even though human and technological error may lead to more close calls that we'd hope, the systems in place to identify mistakes before they escalate might just work well enough to keep nuclear war from happening by accident' Luisa Rodriguez, "How Likely Is a Nuclear Exchange between the US and Russia?," *Rethink Priorities* (blog), June 19, 2019, <https://www.rethinkpriorities.org/blog/2020/6/19/how-likely-is-us-russia-nuclear-war>.



weapon technologies could shift the offense-defense balance¹²³ and undermine nuclear deterrence or taboos. Michael Raska writes that Great Power competition to develop advanced military technologies is intensifying.¹²⁴ If the Long Peace has been strongly shaped by nuclear deterrence, and new weapons tech does not share this strong deterrent factor, then this competition could undermine the existing peace.

Second, the trend towards globalization and more international cooperation could reverse, or the number of democracies in the world could shrink. Either of these changes would raise the likelihood of ideological conflict. While an important determinant of the total prevalence of war, this seems less relevant for this report because the most important prospective Great Power conflicts are already between democratic and authoritarian regimes.

Finally, it is important to note that the future is generally uncertain. A slew of geopolitical, technological, economic, and normative changes are possible. Even if the Long Peace was “real” in that it resulted from substantive changes in international political and military relations, given the preponderance of war throughout human history we should not be certain that these factors will stay so aligned in the future.

Because the future is so uncertain, historical trends and base rates are useful for making predictions. In the next section, we complement this analysis by considering the specific relationships between the strongest contenders for Great Power status in the coming century: the US, China, India, and, if it maintains its nuclear arsenal, Russia. What does the literature on the causes of war suggest we should expect in this world?

Future Great Power conflicts

The world is trending towards multipolarity. In other words, global economic power is becoming more evenly distributed due to high growth rates in India and China. In contrast, since the fall of the Soviet Union economic power has been quite concentrated in the West (Europe and the United States).

¹²³ “Emerging technologies such as low-cost drones could shift the balance between quality—upon which U.S. military forces have traditionally relied—and quantity, as well as between offense and defense. For example, swarms of coordinated, unmanned vehicles could overwhelm defensive systems, providing a greater advantage to the attacker, while directed-energy weapons that provide a low-cost means of neutralizing such attacks, could favor the defender. Thus, emerging technologies could shift the offense-defense balance multiple times over the coming decades” Saylor, “Emerging Military Technologies: Background and Issues for Congress,” 24–25.

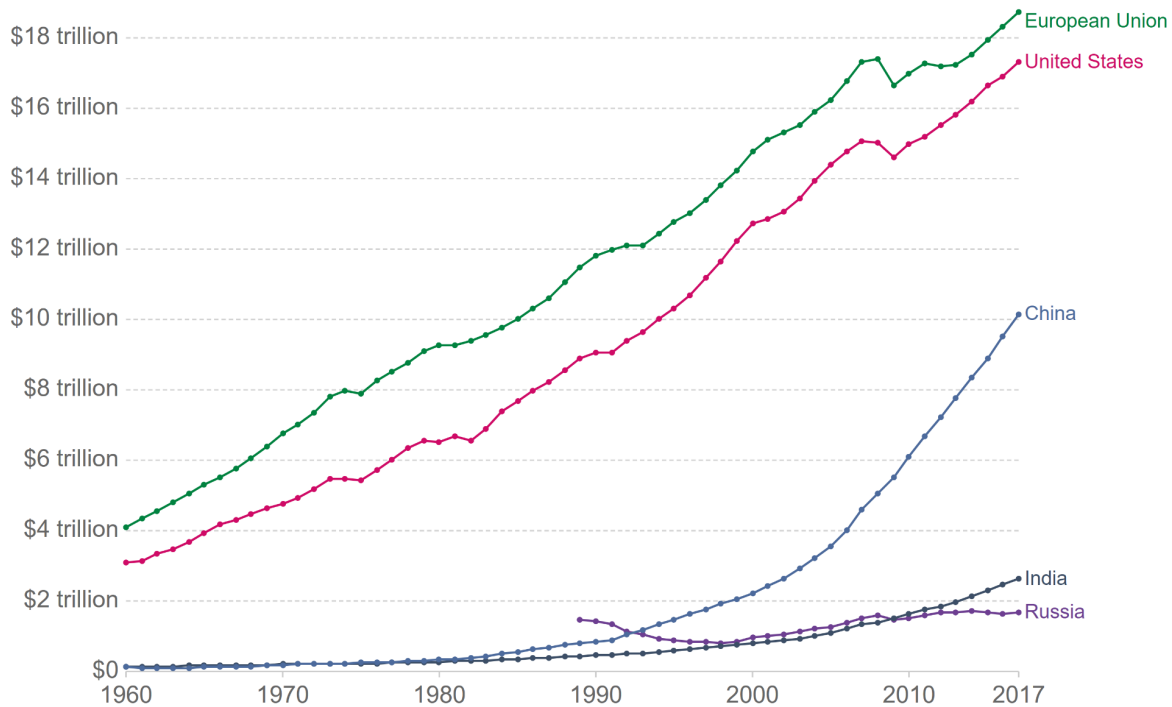
¹²⁴ “The resurgence of great power rivalries, coupled with intensifying arms competition for advanced military technologies suggests that while wars and conflicts are not inevitable, neither are they inconceivable” Raska, “Strategic Competition,” 77.



Gross Domestic Product, 1960 to 2017

Gross domestic product adjusted for price changes over time (inflation) and expressed in US-Dollars.

Our World
in Data



Source: World Bank

OurWorldInData.org/economic-growth • CC BY

Figure 13: GDP growth across regions

Source: "Gross Domestic Product," Our World in Data, accessed July 8, 2021, <https://ourworldindata.org/grapher/gross-domestic-product>.

Some analysts have written that the resurgence of economies outside the western world portends a new, unstable era of Great Power competition.¹²⁵ Whether a multipolar world is more or less stable than a unipolar or bipolar world is debated by academics. Wars have occurred in all types of systems, and different studies have found different results depending on the dataset and research method used. Yet these future trends in polarity do indicate which bilateral relationships may be most important—and most dangerous—in the decades to come. Since there is somewhat more clarity among scholars regarding the causes of war at the bilateral level, here we examine specific relationships between Great Power countries to suggest how much risk they may pose over roughly the next century. The relationships we consider most relevant—for reasons discussed below—are those

¹²⁵ "The resurgence of great power rivalries, particularly notable in East Asia, coupled with intensifying arms competition for advanced military technologies suggests that while wars and conflicts are not inevitable, neither are they inconceivable" Raska, 77.



between the U.S. and China, the U.S. and Russia, and China and India. Each of these involves a pair of countries that we have identified as Great Power contenders with a history of antagonism and rivalry.

U.S.-China

Across many domains, the relationship between the United States and China seems likely to be pivotal in the coming century. They are already the world's two largest economies and, depending on India's growth trajectory, are likely to remain so for years to come. Tensions between the two nations also seem to be growing. At the same time, their economies are strongly interlinked, as China was the U.S.'s largest trade partner for imports and third largest for exports.¹²⁶ This has led many analysts to posit that the U.S. and China are in an era of "strategic competition."¹²⁷ Framed in opposition to a full cooperation or entrenched rivalry, the strategic competition framing highlights that the U.S. and China share some issues on which they can cooperate, and some issues on which they will compete.

Between the poles of alliance and rivalry, though, there are other possibilities. An important question is whether the U.S. and China can avoid escalations on issues where their interests do diverge. Some researchers suggest that this is unlikely; Graham Allison, for example, gave his book on US-China relations the title *Destined for War* to convey the difficulty he believes rivals face when one power is in the process of surpassing another. The U.S. and China also have to contend with the ideological gap between the U.S.'s democracy and China's authoritarian, one-party rule; a history of conflict in Korea and Vietnam; and a growing rivalry that has generated several close calls and escalatory responses. And while the US and China do not share a border or claim any of the same territory, the US's policy of "strategic ambiguity"¹²⁸ with respect to its possible defense of Taiwan raises the spectre of territorial conflict. Each of these factors increase the risk of conflict between countries.

On the other hand, we have already seen that while power transitions such as the one currently underway between the US and China are especially dangerous times, most analyses have found they result in war less than half the time. It is too pessimistic to claim

¹²⁶ "The People's Republic of China," Office of the United States Trade Representative, accessed July 8, 2021, <https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china>.

¹²⁷ "Since the publication of the Trump administration's first National Security Strategy (NSS) on 18 December 2017, there has been much discussion about the extent to which a state of strategic competition exists between the United States and the People's Republic of China (PRC)" Scott D McDonald, "戰略競爭?—Strategic Competition?," *Journal of Indo-Pacific Affairs*, Winter 2020, 3.

¹²⁸ Simon Shin-wei Chen, Wang Kai-chun, and Samuel Hui, "Why US Strategic Ambiguity Is Safer for Taiwan," *The Diplomat*, April 27, 2021, <https://thediplomat.com/2021/04/why-us-strategic-ambiguity-is-safer-for-taiwan/>.



that the U.S. and China cannot avoid war. Still, there are multiple reasons to think that the relationship will be a fraught one given China's rise.

U.S.-Russia

While the PwC analysis expects Russian annual growth to recover and outstrip U.S. annual growth up to 2050, the economic gap between the U.S. and Russia will grow in absolute terms because the American economy is starting from a much larger size. That means that, just as we include Russia as a Great Power due to the size of its nuclear arsenal, the danger posed by its relationship with the U.S. hinges primarily on the risk of this rivalry leading to the use of nuclear weapons—or, potentially, other weapons of mass destruction or dangerous technologies.

Some commentators have observed a resurgence in Russian aggression in recent years, pointing to the 2014 Russo-Ukrainian war as the most striking example. There are several other reasons to worry about the relationship between the U.S. and Russia, which in some ways mirrors the U.S.-China relationship. Although they lack a shared border or territorial claims, an ideological gap and historical rivalry suggest the potential for disputes and escalation.

China-India

Were we to build a checklist of warning signs based on Cashman's review of the causes of war, the China-India relationship would tick almost all of them. They are the most populous countries in the world, each growing quickly and on track to become the largest economies as well. One is democratic and the other authoritarian. And, perhaps most worryingly, they share a long border which is dotted by territorial disputes. Already the two have engaged in deadly border clashes, a classic flashpoint for escalation and conflict spirals. The only mitigating factor is a true double-edged sword: both are nuclear powers. Nuclear powers seem less likely to go to war than other pairs of countries. However, this observation is based on a small sample size, and if such powers did come to blows, the potential for devastation is enormous.

All-things-considered predictions

Combining the breadth of considerations discussed above, generating all-things-considered predictions of future conflict risk is a difficult task.

First, we can consider a simple base rate. Our World in Data's database counts 14 wars over the last 500 years that killed more than 0.1% of the world's population. Three wars occurring in two centuries have included wars that killed more than 1% of the world's



population. If the base rate is constant, over the next 100 years, we are due 2.8 wars that kill at least 8 million people and there's about a 40% chance that a war killing more than 80 million people will occur.¹²⁹

Cirillo and Taleb suggest that the frequency and magnitude of wars has been constant over time. However, since the number of fatalities in war is distributed according to a power law, they also suggest a simple base rate analysis is misguided: the vast majority of events will fall below the mean number of deaths, but a small number of wars will involve far more fatalities than average. Cirillo and Taleb count 504 wars between 1500 and 2015, or 0.98 per year.¹³⁰ Their power law model, though, posits that the deadliest 1% of these conflicts could cause 27 million casualties, and the top 0.1% could kill around 800 million.¹³¹ Over the next 100 years then, we might expect 98 wars. Assuming the death toll from these wars is independently, randomly drawn from Cirillo and Taleb's posited distribution of fatalities, there is a ~60% chance that one of these wars escalates and kills more than 27 million, and 9.3% chance of a war with more than 800 million deaths.¹³² A war of 27 million deaths would be roughly equivalent to WWI or WWII; a war of 800 million deaths would be unprecedented.

Extrapolating Karnofsky's atrocity data with an exponential trend suggests that we should expect large-scale atrocities to be responsible for 52 out of every 100,000 deaths in the 21st century.¹³³ This is significantly lower than the death rate from the 13th, 17th, and 20th centuries. However, because the death rate varies so much from century to century, this prediction is highly uncertain.

None of these predictions account for the possibility that the Long Peace is an enduring phenomenon. If this premise holds, then we should expect the death rate for the 21st century to be lower than a constant death rate or rising atrocity death rate would suggest. In *The Better Angels of Our Nature*, Pinker does not make a prediction about how many conflicts to expect in the decades to come. We can infer, though, that his prediction might

¹²⁹ Two calculations converge roughly to this figure. First, 2 of the last 5 centuries, or 40%, have had such a war. Also, if we assume a constant annual probability of such a war, the chance of one occurring in the next 100 years is given by $1 - (497/500)^{100} = 0.45$

¹³⁰ "Events are generally armed conflicts, such as interstate wars and civil wars, with a few exceptions represented by violence against citizens perpetrated by the bloodiest dictatorships, such as Stalin's and Mao Zedong's regimes" Pasquale Cirillo and Nassim Nicholas Taleb, "On the Statistical Properties and Tail Risk of Violent Conflicts," *Physica A: Statistical Mechanics and Its Applications* 452 (June 2016): 30, <https://doi.org/10.1016/j.physa.2016.01.050>.

¹³¹ "In Table 5, we show these values for both raw and rescaled data [...] According to that table, the top 1% of all armed conflicts have caused (and cause) more than 26.8 million casualties each, when using raw data. And the data also support the 0.1% probability of a war killing something like 800 million of people" Cirillo and Taleb, 41.

¹³² $1 - (.999)^{98} = 0.093$

¹³³ An exponential trendline using Karnofsky's data from the 4th century BC to the 20th century is described by the equation $y = 5.476 * e^{0.1078x}$



lie somewhere between the bounds of a base rate from previous centuries and zero. In other words, Pinker's analysis implies that the risk of a major war in the coming century is lower than it was in previous centuries due to the influence of factors driving the Long Peace. However, he would likely not claim the probability of such a war has been driven completely down to zero.¹³⁴

Arguments regarding the Long Peace's durability should also consider the actual geopolitical characteristics of the world. We suggested earlier that the world is moving towards a multipolar balance of power with three Great Power relationships of most concern. It seems likely that, over the next century, the annual risk of war will be lower than it was during the periods of Great Power competition before each of the World Wars and during the Cold War. This is due to the nuclear taboo, the rise of globalization and international trade, and the decline in territorial disputes. However, it also seems likely that the annual risk of Great Power war will be higher than it was directly following the Cold War. This is because the world's largest economies will be, and already are, governed by different political systems (authoritarian vs. democratic countries) and rivalries often escalate over time.

This could suggest that the risk of war informed by Long-Peace-driven theory is something like one-third to one-tenth as likely as it was in previous centuries. Relative to the base rate analysis, this corresponds to a roughly 4% to 13% chance of a major war (10% on average).

These predictions are generated by different, often incompatible, statistical models. However, we can generate an overall prediction by assigning each of the models a different credence based on how much confidence we have in it. Our credences in these three models are not very robust. An optimal Bayesian approach to identifying the correct theory here would be to take each theory as a different prior for how likely war is each year, and, over time, to update our beliefs about which model is correct as more years pass peacefully. In lieu of this data, though, we have assigned subjective credence on the strength of the arguments the theorists advance: 40% on Pinker's proposal that the modern era is qualitatively different, and more peaceful, than previous centuries, and 60%

¹³⁴ In fact, Pinker himself has written as much in a non-peer-reviewed reply to Taleb's criticisms: "*Better Angels* goes out on a limb and speculates that the chances of all-out nuclear Armageddon were higher during the height of the Cold War than they have been since the Cold War ended. Perhaps that is statistically naïve; I don't think so. It also reviews the most careful analyses I could find on the likelihood of catastrophic chemical, biological, or nuclear terrorism, analyses that examine the technical realities rather than repeating science-fiction and disaster-movie scenarios about nuclear bazaars and garage-built bioweapons. These reviews argue that the chances of catastrophic attacks are considerably lower than those in the predictions of various doomsayers, who predicted, for example, that a nuclear terrorist attack was highly probable by 1990, 2000, 2005, and 2010" Steven Pinker, "Fooled by Belligerence: Comments on Nassim Taleb's 'The Long Peace Is a Statistical Illusion,'" accessed July 5, 2021, https://scholar.harvard.edu/files/pinker/files/comments_on_taleb_by_s_pinker.pdf.



on models that predict our century is roughly as likely to have Great Power wars as previous ones. The arithmetic mean of these forecasts, weighted according to credence, gives the following rough prediction:

Table 3: Forecasts of Great Power war risk				
<i>Model</i>	Base rate (since 1600)	Constant frequency, power law distribution (Cirillo and Taleb)	Durable Long Peace	Combined
p(major war in next 100 years)	.4	.6	.1	.34
Subjective credence	.3	.3	.4	

From these analyses, we can also generate rough bounds for high and low probabilities. The most pessimistic prediction based on general trends is one that assumes a constant frequency of war and Cirillo and Taleb's proposed power distribution: this implies a 60% chance of WWII in the next 100 years and a 10% chance of an unprecedented conflict. A lower bound would be given by a more optimistic analysis that puts a high degree of credence in the durability of the Long Peace. If the annual risk of Great Power war has declined meaningfully since 1945, then we might expect something like a 10% chance of such a war breaking out in the next century.



Forecasters

We can also consider predictions from other forecasters to further calibrate our estimates of the likelihood of future conflict. The degree to which forecasts, especially long-term geopolitical forecasts, are informative is somewhat contentious. Forecasting techniques have grown out of research conducted by Professor Philip Tetlock and described in two major books. *Expert Political Judgment* suggested that expert predictions were often outperformed by simple algorithms or predictions from non-expert generalists.¹³⁵ A follow-up book, *Superforecasting*, identified individuals who were consistently able to score in the top 10 percent of participants in forecasting tournaments run by the U.S.'s Intelligence Advanced Research Project Activity (IARPA).¹³⁶

One key point to note is that we have much more evidence about the performance of forecasting techniques for shorter-term forecasts than we do for longer-term forecasts.¹³⁷ The data that are available suggest that while forecaster accuracy declines as time horizons lengthen, good forecasters still outperform experts on average over these longer time horizons.¹³⁸ Nevertheless, we should treat longer-term forecasts as highly uncertain.

The largest platform for long-term forecasts is Metaculus. The Center for Security and Emerging Technology's Foretell platform also has some long-term, conflict-related forecasting questions. Table 4 below presents a small sample of relevant forecasts, as of July 2021. This is far from comprehensive; we have just used a sample of forecasts to roughly calibrate our own judgements.¹³⁹

¹³⁵ "In aggregate, experts edged out the dart-tossing chimp but their margins of victory were narrow. And they failed to beat: (a) sophisticated dilettantes (experts making predictions outside their specialty, whom I labeled "attentive readers of the New York Times"—a label almost as unpopular as the dart-tossing chimp); (b) extrapolation algorithms which mechanically predicted that the future would be a continuation of the present. Experts' most decisive victory was over Berkeley undergraduates, who pulled off the improbable feat of doing worse than chance." Philip E. Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?—New Edition* (Princeton, N.J.: Princeton University Press, 2017).

¹³⁶ Aidan Goth and Stephen Clare, "Dr. Philip Tetlock's Forecasting Research," Founders Pledge, November 27, 2020, <https://web.archive.org/web/20210427140453/https://founderspledge.com/stories/dr-philip-tetlocks-forecasting-research-high-impact-funding-opportunity>.

¹³⁷ "Unfortunately, by the time of Tetlock (2005), only a few 10-year forecasts (and no 25-year forecasts) had come due, so Tetlock (2005) only reports accuracy results for forecasts with forecasting horizons he describes as "short-term" (1-2 years) and "long-term" (usually 3-5 years, plus a few longer-term forecasts that had come due)" Luke Muehlhauser, "How Feasible Is Long-Range Forecasting?," *Open Philanthropy* (blog), October 10, 2019, <https://www.openphilanthropy.org/blog/how-feasible-long-range-forecasting>.

¹³⁸ "The differing accuracy scores for short-term vs. long-term forecasts in EPJ are sometimes used to support a claim that the accuracy of expert predictions declines toward chance five years out. While it's true that accuracy declined "toward" chance five years out, the accuracy differences reported in Tetlock (2005) are not as large as I had assumed upon initially hearing this claim." Muehlhauser.

¹³⁹ For an up-to-date list of relevant forecasting questions, check the "armed conflict" tag on Metaculus: <https://www.metaculus.com/questions/?search=cat:geopolitics--armedconflict>



Table 4: Aggregated forecasts of Great Power War risk			
<i>Question</i>	<i>Number of predictions</i>	<i>Median forecast</i>	<i>Notes</i>
When will be the next “Great Power” war? (source)	184	2044	Resolves when there is a war between two nations ranked among the top 10 in global military spending
Will there be a global thermonuclear war by 2070? (source)	189	10%	
WWill before 2050? (source)	557	12%	Resolves yes if there are at least 10M casualties in “A military conflict [...] involving countries representing in totality at least 30% of world GDP or 50% of world population in any year in which the conflict is ongoing”
Will there be a US-Russia war by 2050? (source)	56	9%	Resolves yes if there are 1000 battle deaths in a conflict between the US and Russia
Chinese annexation Taiwan by 2050 (source)	368	33%	
Will the Chinese People's Liberation Army (PLA) seize	52	8%	



control of any Taiwanese-occupied features in the South China Sea between August 1, 2021 and March 31, 2022? (from CSET Foretell; source)			
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Rodriguez also cites 2018 forecasts from Good Judgment Inc. superforecasters that suggested a 0.4% annual risk of nuclear war.¹⁴⁰ The question specifically covered the time period between 2018 and 2021. However, were that annual probability to remain roughly constant, there would be a roughly 27% chance of nuclear war between 2021 and 2100.

Overall, we can see that forecasters generally predict around a 10% chance of a major world war in the next 30 to 50 years. This is roughly in line with our analysis in the preceding section; the percentages appear lower due to the shorter time horizon.

Experts

Finally, in addition to forecasters, it could be useful to look at predictions from other experts. Unfortunately, our research has found few such predictions. The most relevant source is a survey of 50 international relations experts conducted in 2015 by the Project for the Study of the 21st Century.¹⁴¹ Experts were asked about the probability of war between different pairs of countries over the next 20 years. The median prediction of the probability of a nuclear great power conflict over that timescale killing more than 80 million people was 5%. The median prediction for the probability of war between the US and China was 18.5%, with a 3.9% chance of nuclear war. For NATO and Russia, there was a predicted 22.6% chance of war (4.7% chance of nuclear war). And for China and India, the chance of war was predicted to be 18.5%, with a 3.9% of nuclear exchange.

Without more data about the background and track record of the experts surveyed, as well as the methods used to generate predictions and the variance in predictions from different experts, we would not update strongly on these results. Nevertheless, they broadly align

¹⁴⁰ Rodriguez, "How Likely Is a Nuclear Exchange between the US and Russia?"

¹⁴¹ Apps, P. (2015). PS21 Great Power Conflict Report (Rep.). Project for the Study of the 21st Century. Retrieved from: <https://www.scribd.com/document/289407938/PS21-Great-Power-Conflict-Report>



with the rest of the analysis here, suggesting an annual probability of Great Power war of between 0.1% and 1%.

Summary

After marshalling the available data on past and future trends, what can we say about the future of Great Power conflict?

First, we can say who is likely to be involved. The U.S. and China will likely be the world's most powerful countries for the next several decades. They are ideologically opposed, caught in an escalating rivalry, and involved in several disputes over territory and alliances. If India can sustain its high economic growth rate, it will come to rival the US and China in the second half of this century. India and China are also ideologically-opposed rivals, with the additional complication that they share a border and disputed territories. The U.S. and Russia are also worth including by dint of their enormous nuclear arsenals, historical rivalries, and ideological differences. While Russia is not an economic competitor of the other countries mentioned here, its nuclear arsenal makes its war-making capacity very large.

Second, we can say something about the relative likelihoods involved. It is not clear whether we live in a world of increasing or decreasing conflict risks. Multiple models fit the data well, and the debate may only be resolved as time passes and more data are collected. But wars are the result of geopolitical, economic, and social processes, not totally random events. Our understanding of these processes is flawed, but our analysis suggests that a nuclear taboo, together with increased international trade and cooperation, has had some pacifying influence. No reasonable person thinks war has been eliminated forever, but there are strong reasons to believe the risk has been lowered. Still, the risks of conflict remain high in absolute terms and seem likely to rise further due to ongoing technological innovation and rising military spending. Overall we think the probability of a major war is at least 10% over the next 100 years. Our best guess is that the probability is even higher, at something like 30%.

In the next section, we dive deeper into what the effects of such a war would be. We focus particularly on the tail risks, the worst effects imaginable, and consider whether they pose a threat to the survival of our species and its long-term future.



4. Great Power War and the Long-term Future

The previous section highlighted an alarming possibility: it may be the case that conflicts are roughly equally likely over time, but are getting ever more deadly.¹⁴² The power law distribution of war deaths, a per-capita death rate from atrocities that is plausibly rising over time,¹⁴³ and an explosion in warmaking capacity since the Industrial Revolution suggest that the risk from future conflicts could be very high. In this section, we consider the most extreme possibility: could a future Great Power war be so destructive that it stops humanity from achieving its potential by causing extinction, the irrevocable collapse of civilization, or permanent lock-in of the victor's sub-optimal values?

Such an event would be an unprecedented catastrophe. Since the future of humanity is extremely valuable in expectation,¹⁴⁴ accounting for the costs of destroying the future, in addition to the suffering inflicted on people currently alive, raises the expected harm of war dramatically. If Great Power war does threaten the future, maintaining the current peace becomes even more important.

How war could threaten the future

Humanity has proven resilient so far. Past wars have been terrible events, killing millions of people. But no war has threatened to extinguish humanity, and civilization has always recovered following conflict. In fact, the effect of the World Wars is barely noticeable in a graph of total world population:

¹⁴² Braumoeller also noted the confluence of these trends in *Only the Dead*, which caused him to write, "When I sat down to write this conclusion, I briefly considered typing, 'We're all going to die,' and leaving it at that [...] f the parameters that govern the mechanism by which wars escalate hasn't changed—and there's no evidence to indicate that they have—it's not at all unlikely that another war that would surpass the two World Wars in lethality will happen in your lifetime. And if it is bigger than the two World Wars, it could easily be a lot bigger" (p.130)

¹⁴³ The death rate from atrocities is plausibly relevant here because, as Karnofsky speculates, it may be the result of a greater centralization of power under the control of states rather than individuals. This trend would help explain why the murder rate is falling even as the atrocity death rate is rising: individuals are less able to get away with committing violence against each other, but more likely to be the victim of coordinated state violence. This state-centered violence can be directed internally, as it was with Stalin's gulags, or externally, as it was with Hitler's foreign invasions.

¹⁴⁴ "To calculate the loss associated with an existential catastrophe, we must consider how much value would come to exist in its absence. It turns out that the ultimate potential for Earth-originating intelligent life is literally astronomical." Nick Bostrom, "Existential Risk Prevention as Global Priority: Existential Risk Prevention as Global Priority," *Global Policy* 4, no. 1 (February 2013): 15–31, <https://doi.org/10.1111/1758-5899.12002>.



Population, 1870 to 2021

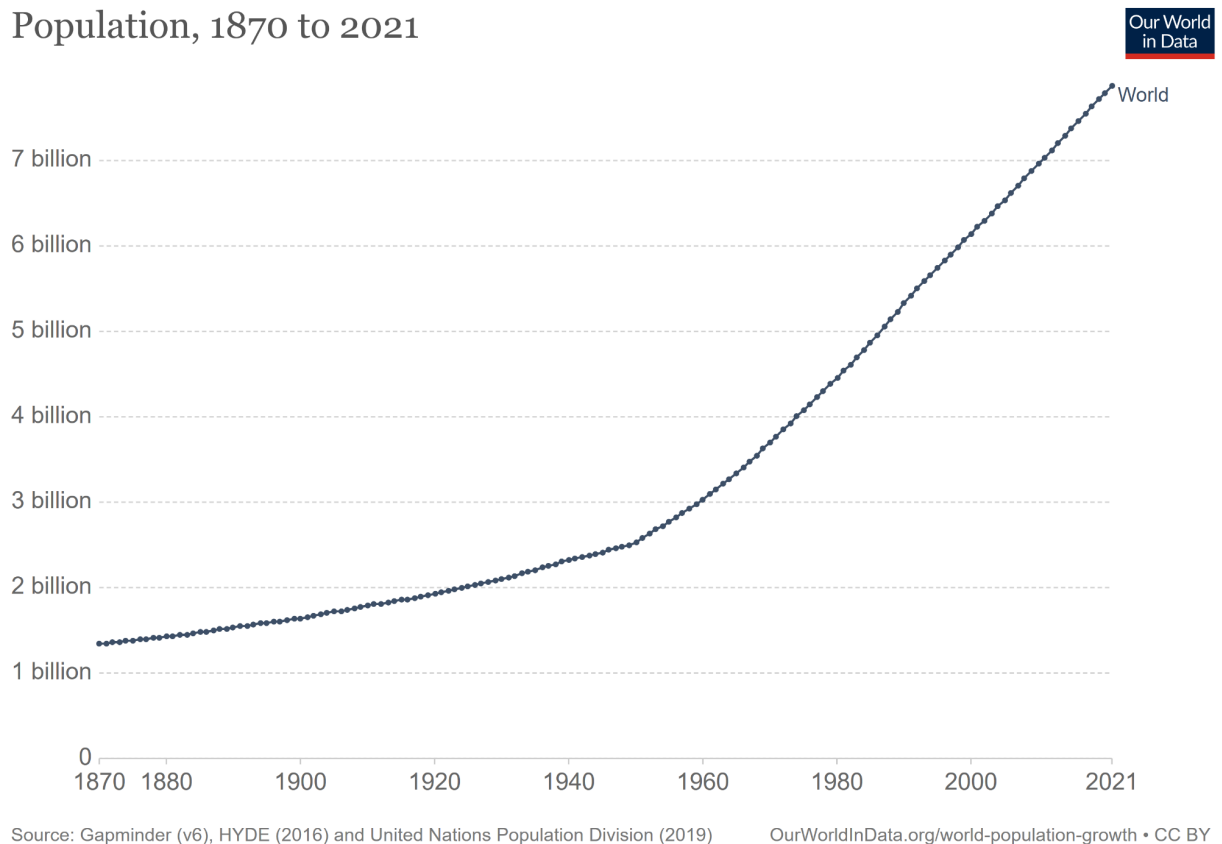


Figure 14: Global population over time

Source: "World Population Growth," Our World in Data, accessed November 26, 2021, <https://ourworldindata.org/world-population-growth>

A war that threatened the entire future would show up in Figure 14 as a precipitous and permanent decline. This means that either the scale of the fighting, the strategies employed, or the types of weapons used would have to be dramatically different than observed in all previous wars. Such a change does not seem impossible. But it does mean that we need new concepts and frameworks to understand the risks. The purpose of this section is to understand how and when a Great Power war crosses this conceptual boundary.

War might directly cause human extinction or civilizational collapse. However, the international tensions that lead to war also have other, indirect effects. For example, they can increase the magnitude of other risks by reducing the flow of information between countries and making it harder to negotiate international agreements. Because we think these indirect effects are also important, we extend the scope of our analysis to include



them. We sort these direct and indirect effects into three broad categories of pathways through which a Great Power war could threaten to wipe out humanity's future:

- I. **Great Power tension could increase others risks.** While not a direct risk itself, rising international tensions could hamper cooperation against other risks or stoke competitive dynamics that increase the danger posed by other major risks
- II. **Great Power war could directly cause a catastrophe.** Either everyone could be killed, or civilization could be damaged so severely that it never recovers.
- III. **Great Power war could combine with another risk to cause a catastrophe.** Human civilization could survive the war, but in a severely weakened state that leaves it vulnerable to subsequent natural or anthropogenic disasters that subsequently end it.

Figure 15 presents a simple causal diagram of how these risk categories relate to each other.

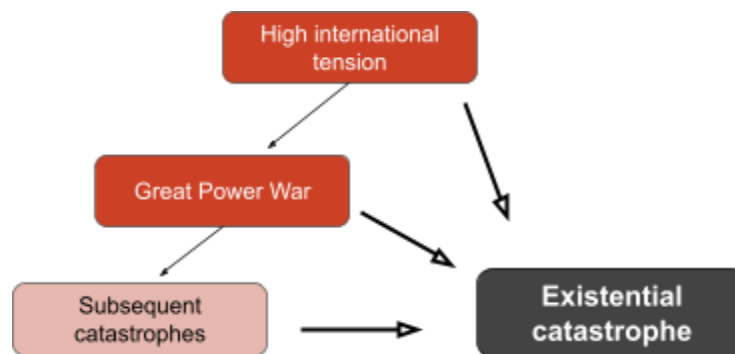


Figure 15: Causal diagram of Great Power War risk

In this section, we briefly describe each of these categories in more detail. We then elaborate on the specific risks which plausibly fall into each category, describe the mechanisms through which they could affect the long-term future, and suggest which should worry us the most. Our goal here is not to build a perfect model of all the possible long-term effects of international cooperation and conflict. Instead, we aim to interrogate



various claims of the long-term significance of Great Power relations^{145,146,147} by identifying concrete causal pathways between international tension and global catastrophes.

The literature here is thin and these pathways are speculative. Although we suggest some probabilities for the different possibilities in order to aid intervention prioritization, we do not claim that these probabilities are especially robust. We expect that future analyses will generate different results. While assigning quantitative probabilities risks communicating an unjustified degree of confidence, we think this cost is outweighed by the benefits of making claims more precise and surfacing specific areas of disagreement. Moreover, putting numbers on our claims helps clarify which factors appear especially important in this analysis and hence where others might usefully disagree and improve upon this work.

I. Great Power tension pathways

Nuclear weapons are arguably the greatest threat to the long-term future that humanity has created so far. While they were invented during World War II, their mass production and the invention of new delivery mechanisms such as submarines and intercontinental ballistic missiles occurred during peacetime, in anticipation of a hot war. This demonstrates one way international tensions and fear of a war can increase threats to the long-term future even when such a war does not break out. Such tensions could raise the danger posed by a number of other risks.

By international tension we mean something akin to “a shared worry about an imminent conflict [which] itself may contribute to starting a war”.¹⁴⁸ We have already seen that tense relations can cause states to increase their military spending¹⁴⁹ and interpret each other’s

¹⁴⁵ Brian Tse, “Risks from Great Power Conflicts” (EA Global 2018, London, October 2018), https://www.youtube.com/watch?v=32eUd3_xSZw&list=PLwp9xeoX5p8OpYjWpNDQnjyTpoelQmy4P&index=6.

¹⁴⁶ Jenny Xiao, “International Cooperation Against Existential Risks: Insights from International Relations Theory,” *Effective Altruism Forum*, January 11, 2021, <https://forum.effectivealtruism.org/posts/sqTW3KhbkDirTh8vJ/international-cooperation-against-existential-risks-insights>.

¹⁴⁷ Jeff Ohl, “International Cooperation as a Tool to Reduce Two Existential Risks,” *EA Forum*, April 19, 2021, <https://forum.effectivealtruism.org/posts/fkN9zcqNeZGrXeeMF/international-cooperation-as-a-tool-to-reduce-two>.

¹⁴⁸ Barry O’Neill, *Honor, Symbols, and War* (Ann Arbor, MI: University of Michigan Press, 1999), 63, <https://doi.org/10.3998/mpub.14453>.

¹⁴⁹ “The military expenditure (M.E.) of a nation depends partly on its wealth as measured by its Gross National Product (GNP), partly on geography, and partly on its presence in an alliance. The authors describe a method for calculating the M.E. value if it depended solely on the GNP; the value of the M.E. so obtained is termed the theoretical M.E. (M.E.Th.). Dividing the actual M.E. by the M.E.Th. (and multiplying by 100) yields a pure number, the tension ratio (T.R.). We regard tension as a function of geography (thus having a hostile neighbor increases tension and having a friendly neighbor decreases



actions as hostile, sparking conflict spirals that escalate to war. But tension can also hamper efforts to cooperate on collective action problems like climate change, or undermine the enforcement of treaties that seek to ban or control the development of dangerous new military technologies. Thus, even if it does not result in full-blown war, bad blood between Great Powers could increase humanity's vulnerability to existential risks. The question is, which risks will be mitigated by cooperation and aggravated by competition?

Causal Pathway 1: Catastrophes otherwise mitigated by international cooperation

Great Powers work together on many different issues. They sign trade agreements, negotiate international treaties, create military alliances and coalitions, encourage or inhibit international migration, and finance development projects in lower-income countries, among many other actions. It is tempting to suggest that international tensions undermine their ability to work together on *all* of these issues. However this would not be accurate, nor would it help much with prioritization. In reality, some of these issues do not have much significance from a very long-term perspective. Others have long-term significance but may not be affected much by Great Power tensions. In this section we focus on a very small number of issues which have clear long-term significance and are likely to be negatively affected by Great Power tension. Figure 16 illustrates the causal pathway from tension to catastrophe.

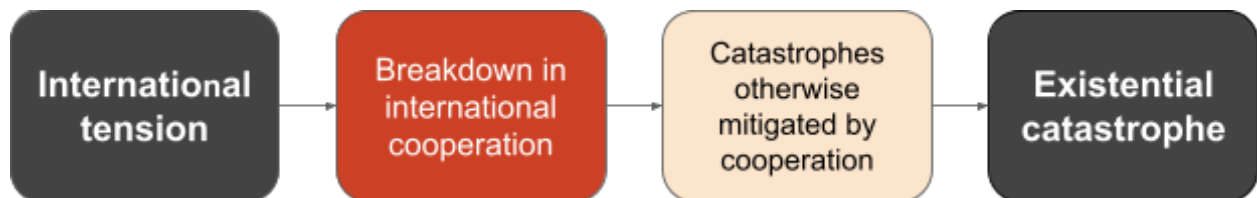


Figure 16: From tension to existential catastrophe

One candidate is climate change. Whether climate change, even extreme climate change, could threaten the continued survival of humanity is unclear. However, this does not mean it can be dismissed. Although global temperatures seem likely to rise by at least 2 degrees

tension) and of membership in an alliance (which should cause a relaxation of tension).” Alan G. Newcombe, Nora S. Newcombe, and Gary D. Landrus, “The Development of an Inter-nation Tensiometer,” *International Interactions* 1, no. 1 (1974): 3–18, <https://doi.org/10.1080/03050627408434382>.



and possibly substantially more,¹⁵⁰ the effects of warming of 4 degrees or more have not been studied extensively.¹⁵¹

Strategic competition, the framework which dominates the U.S.'s current foreign policy towards China, allows for cooperation on non-military issues like climate change.¹⁵² However, the possibility of competing interests with respect to climate action, as well as the increased difficulty of making credible commitments to international agreements when tensions are high, suggest that cooperation will at least be more difficult if diplomatic relations in general are worse.¹⁵³

Another possibility is that international tensions make the development of a dangerous new technology that causes a global catastrophe more likely. State investment in technological research and development helps to drive economic growth. Public funding, including from military sources, has contributed to the invention of technologies ranging from airplanes to the internet.¹⁵⁴ However, technological innovation carries some risk, especially as new technologies grow more powerful and complex. The most concerning of these is the possible invention of a "black ball" technology: one that destroys the civilization that invents it.¹⁵⁵ Candidates for such a technology include weapons that are more destructive than nuclear warheads but even easier to build and artificial intelligence

¹⁵⁰ "On the Webster estimate, there is a 6% chance of 6 degrees of warming, and a 0.1% chance of more than 10 degrees [...] I think the Webster prior is the most plausible" John Halstead, "How Hot Will It Get?," *EA Forum*, April 18, 2020, <https://forum.effectivealtruism.org/posts/Ntathq2o2Frtfa6er/how-hot-will-it-get>.

¹⁵¹ "The big takeaway from looking at the literature on the impact of extreme warming is that the impact of >4 degrees is dramatically understudied." John Halstead, "Is Climate Change an Existential Risk?," accessed July 20, 2021, <https://docs.google.com/document/u/1/d/1qmHh-cshTCMT8LX0Y5wSQm8FMBhaxhQ8OIOeRLkXIF0/edit?>

¹⁵² "All of [the effects of climate change] could throw a serious wrench into the relationships between the world's most influential countries. Of course it is also possible that each of these markets will find ways to cooperate deeply on energy and climate policy while competing with or confronting one another in other issue domains" Bruce Jones, "China and the Return of Great Power Strategic Competition," *Global China: Assessing China's Growing Role in the World* (Washington, DC: The Brookings Institution, February 2020), 8–9.

¹⁵³ "In an age of heightened political competition between great powers, we see an increased focus on the distribution of gains from cooperation [...] The general implications are that it will be harder to deal with problems that are global in nature, or at least transregional in nature" Dani Nedal, "Risks From Great-Power Competition," <https://www.youtube.com/watch?v=OGasSHoFhO8>.

¹⁵⁴ "The Cold War rivalry acted as a stimulus for scientific research and many of the technologies that currently define the information age, most notably the internet, were originally developed for military purposes" Wither, "Warfare, Trends In," 2429.

¹⁵⁵ "What we haven't extracted, so far, is a black ball: a technology that invariably or by default destroys the civilization that invents it. The reason is not that we have been particularly careful or wise in our technology policy. We have just been lucky" Nick Bostrom, "The Vulnerable World Hypothesis," *Global Policy* 10, no. 4 (November 2019): 455, <https://doi.org/10.1111/1758-5899.12718>.



that is more capable than humans but does not share our goals. And, of course, there are probably other technologies, currently difficult to imagine, that would pose such a risk.

One way international tensions could make technology research and development more dangerous is by fostering an arms race dynamic which prioritizes speed at the expense of safety. This would make it more likely that humanity draws a black ball technology. International cooperation may reduce these risks. For example, international agreements can change the behaviour of actors to reduce the chance disasters occur in the first place; a coordinated international crisis response can stop small issues from escalating to major threats.

Higher international tensions, especially between Great Powers, harm the international community's ability to act in concert and respond to various threats. During the Cold War, for example, the U.S. and the Soviet Union each used their veto liberally to block many of the actions proposed in the UN Security Council. Since the end of the Cold War in 1989, the Security Council has been able to pass many more resolutions and its members have lodged fewer vetoes.¹⁵⁶ The flow of information internationally could be slowed if countries in tension curb business, cultural, and academic exchanges. States may do this if they fear that more open exchanges will increase bilateral flow of technological knowledge and speed up the development of their rivals. For example, in 2020 the U.S. government implemented tighter visa restrictions for Chinese students studying in America.¹⁵⁷ Meanwhile, the Chinese government has taken steps to limit the ability of foreign NGOs, especially politically-engaged ones, to operate in China.¹⁵⁸

Our stance is that climate change and technology governance are the issues where international cooperation and catastrophic risks most clearly intersect. However, it is likely that other important issues and connections will emerge in the future. Overall, we are

¹⁵⁶ "[T]he body is still a long way from descending into Cold War-level paralysis. While P5 relations reached another low point in 2014, the Council has continued to show encouraging signs of vitality. Notwithstanding two vetoes, in 2014, the Council adopted 63 resolutions, 60 of which unanimously, including the 32 resolutions under Chapter VII of the UN Charter (which allows for enforcement action). This confirms two remarkable trends of the post-Cold War era: first, that towards consensus decision-making in the Council, with at least 90% of resolutions since 2001 adopted by consensus; and second, a trend towards the ever greater resort to Chapter VII of the UN Charter, with the share of such resolutions rising from 25% in 2000 to above 60% since 2010" Sebastian von Einsiedel, David M Malone, and Bruno Stagno Ugarte, "The UN Security Council in an Age of Great Power Rivalry," n.d., 3.

¹⁵⁷ Edward Wong and Julian E. Barnes, "U.S. to Expel Chinese Graduate Students With Ties to China's Military Schools," *The New York Times*, May 28, 2020, sec. U.S., <https://www.nytimes.com/2020/05/28/us/politics/china-hong-kong-trump-student-visas.html>.

¹⁵⁸ Nectar Gan, "Why Foreign NGOs Are Struggling with New Chinese Law," *South China Morning Post*, June 13, 2017, sec. Politics, <https://www.scmp.com/news/china/policies-politics/article/2097923/why-foreign-ngos-are-struggling-new-chinese-law>.



unsure about how strong a risk factor international tension is. A full accounting would require calculating the difference in risk level in a world of high tension and a world of low tension for each of the risks discussed in this section. One would have to speculate about the likelihood that other, hidden risks are affected by international tension. This exercise is beyond the scope of this report. We do think it plausible that international tension is a significant risk factor. For example, we think it likely that Great Powers are much more likely to negotiate and commit to international agreements on the governance of advanced AI systems if tensions are low. International tension does not preclude such agreements; the U.S. and the Soviet Union, for example, negotiated limits on the size of their nuclear arsenals during the Cold War. But tension surely makes such agreements more difficult to reach and enforce.

II. Great Power war pathways

The deadliest war in history was World War II, in which about 75 million people, or 3% of the world's population, were killed.¹⁵⁹ This means that while WWII was catastrophic for the world and millions of people, it did not come close to wiping out humanity. A war causing extinction would have to be more than 30 times as deadly. This is not inconceivable. For example, one can imagine future weapons that combine extreme lethality with extreme precision, providing the technical capacity to exterminate the global population.

Another possibility is that a Great Power war could destroy humanity's future without killing everyone. There are two different ways this could happen. The war could damage human civilization so severely that it could never recover. Or, it could leave humanity more vulnerable to subsequent catastrophes. In this section we examine the direct risk of a war either killing everybody or permanently weakening civilization. The risk of subsequent catastrophes is discussed in the next section.

Causal Pathway 2: Technological Disaster

In the previous section we discussed how the risk that technological development poses to the long-term future is worse when international tensions are high. Many of these issues are further heightened for military technologies or dual-use technologies which have both civilian and military application. The pathway from technological innovation to existential catastrophe is shown in Figure 17.

¹⁵⁹ "World War II Casualties," in *Wikipedia*, July 12, 2021, https://en.wikipedia.org/w/index.php?title=World_War_II_casualties&oldid=1033305124.

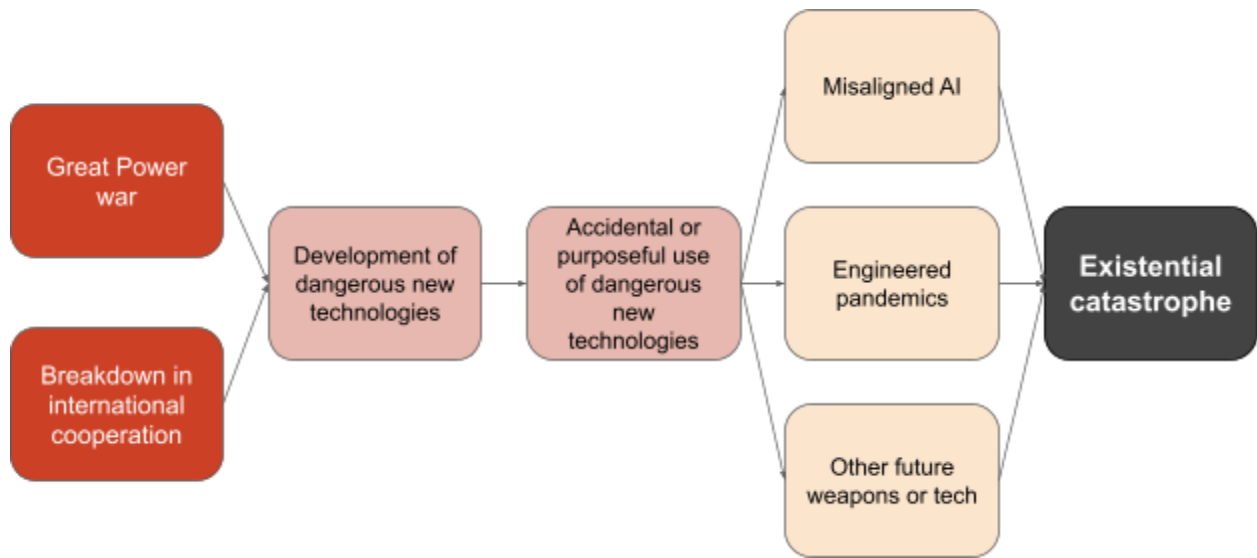


Figure 17: Technological innovation and existential catastrophe

Several characteristics of military technology foster this dynamic. First, military competition is particularly intense, paranoid, and aggressive.¹⁶⁰ Research into technologies with military applications is conducted in secret, behind layers of classification and without third-party accountability or oversight.¹⁶¹ Military strategists may be more likely to take risks and invest more in potentially dangerous technologies themselves when the capabilities of their opponents are unclear.¹⁶² Even in scenarios where both sides have “defensive” or “status quo” intentions, “insecurity and uncertainty about the other’s true intentions” can produce a security dilemma and lead to an arms race.¹⁶³ The technologies under development are powerful and complex, as are the systems built to manage their

¹⁶⁰ “Richly endowed nation-state rivals operate with great paranoia and little inhibition. In military competitions security agencies presume sabotage, indeed proudly practice it. Even botched attempts at sabotage increase the risks of accidents and unintended effects. Moreover, fear of military opponents intensifies willingness to take risks: If they might be doing X, we must do X to keep them from getting there first, or at least so that we understand and can defend against what they might do” Richard Danzig, “Technology Roulette: Managing Loss of Control as Many Militaries Pursue Technological Superiority” (Center for a New American Security, June 2018), 8.

¹⁶¹ “Civilian uses of complex technologies are commonly subject to review, oversight, and regulation [...] In contrast, military systems have very limited visibility in the United States and much less still in authoritarian nations” Danzig, 7.

¹⁶² “Moreover, fear of military opponents intensifies willingness to take risks: If they might be doing X, we must do X to keep them from getting there first, or at least so that we understand and can defend against what they might do” Danzig, 8.

¹⁶³ “Security dilemmas are situations in which both sides have defensive, or status quo, intentions and would prefer to avoid costly and destabilizing competition and mutual arming. Yet because of insecurity and uncertainty about the other’s true intentions, each side concludes that it has no alternative” Adam P. Liff and G. John Ikenberry, “Racing toward Tragedy?: China’s Rise, Military Competition in the Asia Pacific, and the Security Dilemma,” *International Security* 39, no. 2 (October 2014): 52–91, https://doi.org/10.1162/ISEC_a_00176.



use.¹⁶⁴ As a result, using technology to enhance military power entails many collateral risks, including “unintended consequences of complex systems, errors in analysis or operation, interactive effects between separately developed systems, and distortions introduced by sabotage.”¹⁶⁵ Military technologies are deployed across many different environments and in high-stress combat situations, are used by operators of various skills, and are interdependent with other complex systems.¹⁶⁶

Possessing such technologies increases a state’s military might, changing the international balance of power. This means that states are likely to race to develop such technologies in order to gain an advantage over their rivals or to prevent their rivals from gaining a decisive advantage over them. Arms race dynamics are sensitive to unreliable estimates of the opposing side’s capability. While some analyses suggest that military planners tend to overestimate the strength of opposing forces, others find that such estimates vary widely depending on organisational and informational factors.¹⁶⁷ Scenarios in which rival states share mutual suspicions and it is difficult to verify commitments to de-escalation may be most likely to drive arms race dynamics.¹⁶⁸

¹⁶⁴ “[T]he power and consequence of military weapons demand special attention to technologies related to these systems. Technological developments determine not only the character of these weapons, but also of the sensor, communication, and analytic systems that in large measure determine whether and how weapons are used” Danzig, “Technology Roulette: Managing Loss of Control as Many Militaries Pursue Technological Superiority,” 7.

¹⁶⁵ Danzig, 4.

¹⁶⁶ “Despite hierarchies of command, rigid procedures, intense training, and elaborate screening of people and plans, military systems have attributes that make them especially prone to human error, emergent effects, misuse, and misunderstanding. These include the secrecy associated with advanced weapons development and use; the unpredictability of operational interactions and environments; the mismatch between experts’ skills and military assignments; the interdependencies and vulnerabilities that exist between military systems, especially on the scale of the U.S. military; the urgent deployment of new technologies to meet battlefield operational needs; and finally, the unconstrained nature of military competition” Danzig, 7.

¹⁶⁷ “It is clear that U.S. estimates of the Soviet threat changed markedly and then endured over long time periods. Also apparent is that critical inferences rested on assumptions with limited factual grounding. Different analysts drew different conclusions from the same evidence and held to these inferences despite new developments, acknowledged informational deficiencies, and an unenviable forecasting record. Rather than base assessments on adversary capabilities, analysts forged assessments around fairly crude assumptions about adversary intent” James H. Lebovic, “Perception and Politics in Intelligence Assessment: U.S. Estimates of the Soviet and ‘Rogue-State’ Nuclear Threats,” *International Studies Perspectives* 10, no. 4 (November 2009): 407, <https://doi.org/10.1111/j.1528-3585.2009.00385.x>.

¹⁶⁸ “A type-1 strategic setting is characterized by a traditional security dilemma—that is, a situation in which security relations between potential rivals are unstable and defined by mutual suspicions of each other’s intentions but where both sides are status quo, defensive-oriented states. Despite having aligned interests, they nevertheless are engaged in a destabilizing action-reaction cycle whereby moves to enhance one’s own security for defensive reasons are seen by the other side as evincing potentially offensive intentions. A vicious cycle ensues, as the other side judges it has no choice but to employ countermeasures. If the two sides could credibly signal their benign intentions—both now and in the



The likelihood of an arms race also depends on the nature of the weapons available to states. The development of new “first-strike” weapons, which give an advantage to the side that strikes first, has, historically, been especially likely to spark an arms race.¹⁶⁹ This makes the potential development of new first-strike weapons, especially very powerful ones, particularly concerning.

Future technological developments have the potential to dramatically change the nature of warfare: control of emerging technologies is a critical component of military power.¹⁷⁰ Great Power states are expected to make significant investments in advanced technologies in order to bolster their national defense and maintain strategic advantages over competing states. For that reason, the emerging, multipolar era has been called a time of “strategic competition”. Competing interests and tension between the most powerful countries are expected to drive competition across a range of economic and geopolitical domains.^{171,172}

Already there are indications that contemporary Great Powers are investing heavily in developing advanced technologies with strategic military interests in mind. China’s medium- and long-term defense strategies are currently guided towards plugging two key “gaps,” one of which involves bolstering “indigenous innovation” capacity to catch up to the technological frontier and reduce dependence on foreign inventions.¹⁷³ Similarly, in 2012 Russia established a domestic Advanced Research Foundation to support domestic

future—they would seek a “bargain” to reduce military competition.” Liff and Ikenberry, “Racing toward Tragedy?,” 63.

¹⁶⁹ “Among the most destabilizing weapons systems, which stimulate rapidly escalating arms races and also may lead to the outbreak of hostilities during a crisis, are so called ‘first-strike weapons’, which are vulnerable and at the same time highly destructive” Fischer, “Economics of War and Peace, Overview,” 665.

¹⁷⁰ “Emerging technologies such as AI are widely regarded to be a crucial element of future military effectiveness and advantage. In theory (and often in practice), the possession of cutting-edge militarily relevant technologies equals more effective weapons systems, which in turn results in greater military power, which in turn translates into greater geopolitical power” Raska, “Strategic Competition,” 66.

¹⁷¹ This is discussed at length in Raska, “Strategic Competition.”

¹⁷² “The more likely scenario is that both Washington and Beijing, pushed by their allies/partners and aware of the substantial costs to themselves of direct confrontation, instead pursue a strategy of strategic competition. This would still entail substantial risk, but less quickly and less directly” Jones, “China and the Return of Great Power Strategic Competition,” 8.

¹⁷³ “Confronting these challenges, China has progressively introduced a series of medium- and long-term defense industrial strategies, plans, and institutional reforms that have generally set two broad strategic objectives known as “two gaps:” to catch-up with the global military-technological state-of-the-art base by fostering “indigenous innovation,” mitigate foreign dependencies on technological transfers and arms imports, while leveraging civil-military integration to overcome entrenched barriers to innovation; and to provide advanced weapons platforms, systems, and technologies that would enable the PLA’s transformation into a fully “informatized” fighting force” Raska, “Strategic Competition,” 70.



research into “high-risk, high-pay-off technologies” like advanced AI and “cognitive technologies.”¹⁷⁴

These kinds of technologies could be deployed accidentally or purposefully and cause major damage. An accident may result from a test gone wrong or an accidental release in response to a false alarm or human error. Because militaries work with dangerous, novel technologies, they are highly accident-prone.¹⁷⁵ Purposeful deployment would seem extremely unlikely given that, by definition, we are discussing events that harm everybody alive, not just enemy combatants. But the effects of the weapon could be different on the battlefield than in test environments. Alternatively, militaries could choose to deploy untested weapons where some degree of risk is known if they are in a high-stress combat environment or feel they are at risk of losing a war.¹⁷⁶

We highlight two emerging technologies with military applications which experts have identified as particularly likely to pose grave threats to humanity. We also include the possibility that other future technologies beyond AI and bioweapons could pose such a threat. Nuclear weapons are discussed in the next section.

Misaligned Artificial Intelligence (AI)

The potential risks posed by advanced artificial intelligence systems are discussed in some detail in Founders Pledge’s report on Safeguarding the Future.¹⁷⁷ That report notes that:

- Using machine learning approaches to develop AI systems has driven rapid progress in this area across many different functions
- It seems likely that AIs will be able to perform more tasks in the future, and perform them better, more quickly, and more reliably
- Applying AI techniques to problems in medicine, transport, scientific research, and other fields seems likely to generate significant benefits for humanity. However, many researchers and other prominent figures have also voiced concerns about

¹⁷⁴ Raska, 73.

¹⁷⁵ “Militaries expect high performance from their forces, often while they are performing dangerous tasks, but militaries neither demand nor expect accident-free operations in most settings [...] Accidents overall accounted for nearly 32 percent of U.S. servicemember deaths [from 2006 to 2020], and even accounted for a significant portion of servicemember deaths in Iraq (19 percent) and Afghanistan (16 percent)” Paul Scharre, “Debunking the AI Arms Race Theory,” *Texas National Security Review* 4, no. 3 (Summer 2021), <https://tnsr.org/2021/06/debunking-the-ai-arms-race-theory/>.

¹⁷⁶ “In evaluating new technologies, militaries may be relatively accepting of the risk of accidents, which may lead them to tolerate the deployment of systems that have reliability concerns” Scharre.

¹⁷⁷ See pp. 46-54 of John Halstead, “Safeguarding the Future,” Cause Area Report (Founders Pledge, December 2020).



downside risks from misalignment between the goals and actions of powerful AI systems and humans

- While the development of such advanced AIs in the coming decades may seem far-fetched, when researchers are surveyed they tend to put a substantial probability on the possibility of such systems being developed within the 21st century¹⁷⁸

The US military, at least, is investing in AI technology, but such investments are a fraction of the total military budget at this time.¹⁷⁹ Roughly the same seems probably true for China, Russia, and India. However, this does not mean that it is not worth worrying about military applications of AI. Several potential implications are particularly concerning. The first is that AI systems could accelerate the pace of warfare, even beyond the ability of humans to comprehend, thereby pushing people out of the decision-making loop.¹⁸⁰ Clearly, this would cause humans to lose control of warfare. A second concern is that the safety-speed trade-off discussed under Causal Pathway 1 seems to be especially concerning for AI systems.¹⁸¹ Pressure to develop AI systems quickly may be quite strong if tensions are high and the threat of war is imminent. Current AI systems may be more unpredictable and accident-prone than many other types of technologies: one example is so-called “specification gaming,” in which machine learning algorithms achieve the literal objective function given but do so in a way that does not actually satisfy the intended aim.¹⁸²

¹⁷⁸ “AI researchers tend to put a substantial probability on AI systems achieving human performance on most relevant tasks this century. In a 2014 survey of the 100 most-cited AI researchers (only 29 of whom responded), respondents gave a one in two chance of human-level AI systems by 2050, with AI systems probably surpassing humans 30 years after reaching the human level. In a larger survey by Grace et al. (2017), AI researchers gave very different answers depending on how an effectively identical question was framed: framing as a question about when all jobs would be fully automated produces a median estimate after 2100; but framing as a question about AI systems surpassing humans at all human tasks produces a median estimate of around 2060” Halstead, 48.

¹⁷⁹ “An independent estimate by Bloomberg Government of U.S. defense spending on AI identified \$5 billion in AI-related research and development in fiscal year 2020, or roughly 0.7 percent of the Department of Defense’s over \$700 billion budget” Scharre, “Debunking the AI Arms Race Theory.”

¹⁸⁰ “At some point, warfare could shift to a qualitatively different regime in which humans have less control over lethal force as decisions become more automated and the accelerating tempo of operations pushes humans “out of the loop” of decision-making” Scharre.

¹⁸¹ “[O]ut of a desire to field AI capabilities ahead of competitors, militaries may be more willing to accept risk than they might otherwise be and to field systems that are prone to mishaps” Scharre.

¹⁸² “Specification gaming is a behaviour that satisfies the literal specification of an objective without achieving the intended outcome. [...] This problem also arises in the design of artificial agents. For example, a reinforcement learning agent can find a shortcut to getting lots of reward without completing the task as intended by the human designer. These behaviours are common, and we have collected around 60 examples so far (aggregating existing lists and ongoing contributions from the AI community). In this post, we review possible causes for specification gaming, share examples of where this happens in practice, and argue for further work on principled approaches to overcoming specification problems.” Victoria Krakovna et al. Deepmind. “Specification gaming: the flip side of AI ingenuity.” Accessed November 1, 2021.



Engineered Pandemics

Founders Pledge's report on Safeguarding the Future¹⁸³ further notes that:

- We should expect to see more frequent pandemics for a number of reasons: the human population is much larger than ever before, factory farming brings many animals together in unsanitary conditions and into close contact with humans, and we live in dense, interconnected environments that are conducive to pathogen spread.
- On top of these conditions, future advances in biotechnology will allow humans rather than evolution to determine the features of pathogens, increasing the risk humanity faces from Global Catastrophic Biological Risks (GCBRs)¹⁸⁴
- The accessibility and costs of these methods has already fallen significantly,¹⁸⁵ and is expected to fall further in the coming decades

Research into biological weapons for military ends has already occurred at a large scale. The Soviet Union, for example, ran a large, offensive biological weapons program from the 1920s up until the 1990s.¹⁸⁶ The Soviets continued to expand this program after signing the Biological and Toxic Weapons Convention in 1972. The program was highly classified and shrouded in misinformation. Such conditions heightened the risk of accidents, and indeed, in 1979 a bioweapons lab in the Soviet Union city of Sverdlovsk accidentally released

¹⁸³ See pp. 41-6 of Halstead, "Safeguarding the Future."

¹⁸⁴ "Creating a pathogen that would threaten human civilisation is impossible at present, but it is a real possibility that we will gain the ability at some point in the next century, as biotechnology improves" Halstead, 42.

¹⁸⁵ "The Human Genome Project was the largest ever scientific collaboration in biology. It took thirteen years and \$500 million to produce the full DNA sequence of the human genome. Just 15 years later, a genome can be sequenced for under \$1,000 or within a single hour. The reverse process has become much easier too: online DNA synthesis services allow anyone to upload a DNA sequence of their choice then have it constructed and shipped to their address. While still expensive, the price of synthesis has fallen by a factor of a thousand over the last two decades and continues to drop. The first ever uses of CRISPR and gene drives were the biotechnology achievements of the decade. But within just two years each of these technologies were used successfully by bright students participating in science competitions." (Toby Ord, *The Precipice: Existential Risk and the Future of Humanity* (Bloomsbury Publishing, 2020), 134.)

¹⁸⁶ "In 1972, the United States, the Soviet Union and other nations signed the Biological and Toxin Weapons Convention that was supposed to ban biological weapons. At that very time, however, the Soviet Union was embarking on a massive expansion of its offensive biological weapons program, which began in the 1920s and continued under the Russian Federation at least into the 1990s." Steven Aftergood, "The History of the Soviet Biological Weapons Program," *Federation of American Scientists* (blog), July 18, 2012, https://fas.org/blogs/secretcy/2012/07/soviet_bwl/.



weaponised anthrax when an air filter was taken off for cleaning. At least 66 people died as a result.¹⁸⁷

The deliberate release of a biological agent that had the potential to cause an extinction-level catastrophe would arguably be so self-destructive that it is not a possibility worth spending a great deal of time on. However, merely possessing such a weapon could be strategically useful. Such agents have already been released accidentally, and the number and lethality of such agents is likely to increase in the future.

Other future weapons or technology

Finally, it is possible that other dangerous military technologies will be invented this century. Technologies may have surprising effects and timelines for their invention are unpredictable. Barring large economic or geopolitical changes, we expect Great Power competition to continue throughout the 21st century. If technological progress continues at its current pace, it seems likely that new risks will emerge.

Causal Pathway 3: Nuclear War

Of the technologies available to militaries today, one stands out as posing a particularly large threat. The first nuclear weapon, detonated in 1945, represented a huge increase in the amount of destructive power available to humanity; the device was thousands of times more powerful than other bombs available at the time.¹⁸⁸ Modern thermonuclear weapons are even more powerful than the first bombs tested. The most powerful nuclear weapons in service today are between 50 and 100 times more powerful than the bombs that were dropped on Hiroshima and Nagasaki at the end of World War II.¹⁸⁹ A single Soviet-era thermonuclear warhead has thirty times more destructive power than all the bombs the United States dropped on Germany in World War II combined.¹⁹⁰ The third causal pathway

¹⁸⁷ “A bioweapons lab in one of the Soviet Union’s biggest cities, Sverdlovsk, accidentally released a large quantity of weaponized anthrax, when they took an air filter off for cleaning. There were 66 confirmed fatalities.” Ord, *The Precipice: Existential Risk and the Future of Humanity*.

¹⁸⁸ “[T]he advent of nuclear weapons was a striking technological discontinuity in the effectiveness of explosives. In 1940, no one had ever made an explosive twice as effective as TNT. By 1945 the best explosive was 4500 times more potent, and by 1960 the ratio was 5 million” “AI and the Big Nuclear Discontinuity,” AI Impacts, January 9, 2015, <https://aiimpacts.org/ai-and-the-big-nuclear-discontinuity/>.

¹⁸⁹ “Nuclear Weapon Yield,” in *Wikipedia*, March 31, 2021, https://en.wikipedia.org/w/index.php?title=Nuclear_weapon_yield&oldid=1015236702.

¹⁹⁰ “The destructive power of nuclear-armed states dwarfs anything in earlier history. In three years of bombing, 1942-45, the U.S. Eighth Air Force dropped 700,000 tons of TNT on Germany; on Halloween 1961, the Soviet Union tested a single bomb... with a yield equivalent to 50– 57 million tons of TNT. By 1966 a single Soviet SS-9 Model 2 missile could carry a warhead equivalent to 25 million tons of TNT, more than thirty times the destructive power of all the bombs the United States dropped on Germany in World War II; and by the 1970s the Soviet Union had deployed 255 of these ICBMs” Ian Morris, *The*



we discuss is the possibility that a Great Power war in which hundreds or thousands of these weapons were used could cause an irreversible global catastrophe (Figure 18).

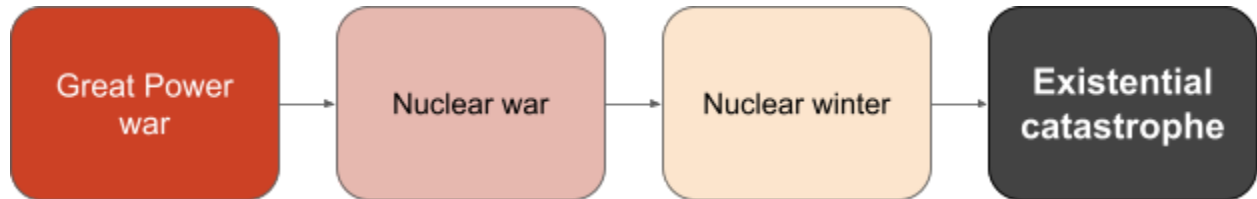


Figure 18: Nuclear pathways to existential catastrophe

While the number of these weapons in the world has fallen by more than 80% from its peak in the late 1980s, about 13,000 remain. Each of the US and Russia have more than 5,500 nuclear warheads, roughly 1350 of which are actively deployed on bombers or missiles.¹⁹¹ These arsenals represent more than 90% of the world's total number of nuclear weapons; China, France, the UK, India, Pakistan, Israel, and North Korea combined have an additional ~1260 warheads.

Despite the proliferation and military potential of nuclear weapons, they have been used offensively just twice (at Hiroshima and Nagasaki) and not at all since 1945. Instead, the ability of a nuclear-armed state to launch a retaliatory attack (second-strike potential), the potential for a nuclear attack to trigger globally-catastrophic outcomes, and strong international norms and agreements against nuclear first-strikes have led military strategists to avoid using such weapons, and to avoid escalating any situations which could plausibly lead to their use.

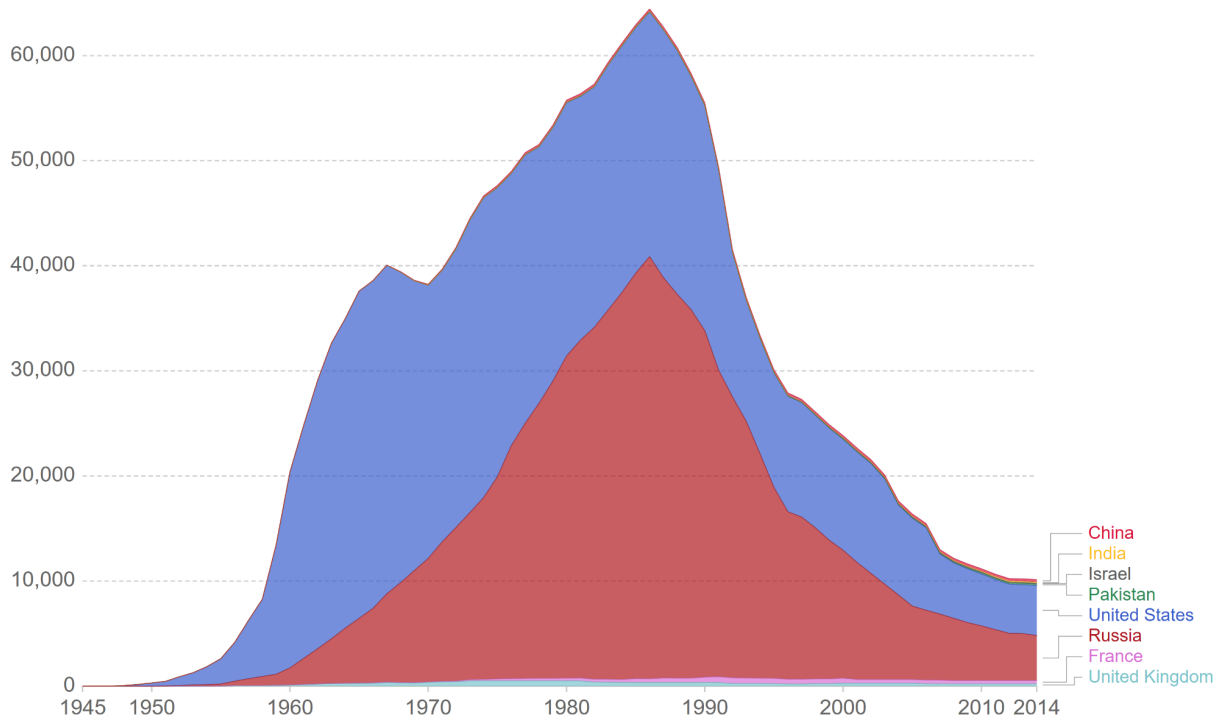
Measure of Civilization: How Social Development Decides the Fate of Nations (Princeton: Princeton University Press, 2013), 176. (quoted in Luke Muehlhauser, "How Big a Deal Was the Industrial Revolution?," *Luke Muehlhauser* (blog), n.d., <http://lukemuehlhauser.com/industrial-revolution>.)

¹⁹¹ See figure: "2021 Estimated Global Nuclear Warhead Inventories" in "Nuclear Weapons: Who Has What at a Glance," Arms Control Association, August 2020, <https://www.armscontrol.org/factsheets/Nuclearweaponswhohaswhat>.



Number of nuclear warheads in the inventory of the nuclear powers, 1945 to 2014

Our World
in Data



Source: FAS Nuclear Notebook

OurWorldInData.org/nuclear-weapons/ • CC BY

Figure 19: Nuclear inventories

Source: "Nuclear Weapons," Our World in Data, accessed November 26, 2021, <https://ourworldindata.org/nuclear-weapons>

In the 80 years since nuclear weapons were first invented, however, there have been multiple points at which they could plausibly have been used. These fall into two broad categories: first, regional or incipient military confrontations that threatened to escalate, and second, near-accidents in which false alarms or human error could have led to nuclear launches in response to an illusory threat. At several times during the Cold War, nuclear weapons were almost used. The most infamous instance was the Cuban Missile Crisis. At multiple times during the crisis, leaders contemplated escalating the conflict despite the fact that nuclear weapons were involved.

But the Cold War presented several opportunities where leaders could have plausibly chosen to escalate conflicts. These include: the Berlin Wall crisis, a showdown between American and Soviet tanks after East German police denied an American diplomat entry to



East Berlin¹⁹²; the Berlin airlift, when an American general contemplated an invasion of East Germany to supply allies trapped in Berlin;¹⁹³ the Vietnam war, in which Soviet and American forces came into close contact;¹⁹⁴ and the Korean War, in which American soldiers fought Chinese soldiers and Soviet pilots flew covert missions against US forces.¹⁹⁵

¹⁹² "In October 1961, a few months after the Berlin Wall went up, an American diplomat tried to cross through "Checkpoint Charlie" into East Berlin. The East German police – whose authority the United States did not recognize – demanded papers. The diplomat refused, and later came back with jeeps and soldiers. Again, the local cops demanded he accede to their demands. This time, the Americans sent tanks. The Soviets, having been alerted to the situation, also sent tanks of their own. For three days, the U.S. and the USSR stared down each other's gun barrels on a German street. Finally, the Americans quietly proposed that the Soviets test the waters by pulling back one tank. They did so, and the Americans reciprocated. The crisis was over, but West Berlin remained until 1989 a Western outpost in the midst of the Communist camp." Nichols, Tom (Professor of National Security Affairs at the Naval War College and a professor at the Harvard Extension School). "Five Close Calls With Death: How the Cold War Nearly Went Nuclear." Text. The National Interest. The Center for the National Interest, November 8, 2020.

<https://nationalinterest.org/blog/reboot/five-close-calls-death-how-cold-war-nearly-went-nuclear-172099>.

¹⁹³ "Until vetoed by General Clay, the ground commander, LeMay reportedly favoured a provocation in which his B-29s would be in the air, with fighter escort, and heading for the Soviet air force fields, while American troops attempted to force their way into Berlin. Indeed, the B-29 deployment appears to have been LeMay's brainchild back in the spring of 1948, before the blockade was imposed. But far from atomic attack, his plans were eerily reminiscent of his attacks on Tokyo — B-29s, carrying minimum fuel, fully laden with high explosive, flying low against their targets." Young, Ken. "US 'Atomic Capability' and the British Forward Bases in the Early Cold War." *Journal of Contemporary History* 42, no. 1 (January 2007): 117–36. <https://doi.org/10.1177/0022009407071626>.

¹⁹⁴ "In November 1965, Lyndon Johnson reportedly exploded with rage at a meeting with the Joint Chiefs, who wanted him to go bigger in the newly launched intervention in Vietnam. Johnson swore a blue streak at them for being willing, in his view, to risk nuclear war over Vietnam. As it turns out, Johnson wasn't the only one having a problem with generals. After the Soviet collapse, previously censored memoirs of a Khrushchev political ally, Anastas Mikoyan, were finally published in Russia. Mikoyan related a chilling story, also from 1965: the Soviet General Staff, incensed by the U.S. bombing of Vietnam and earlier U.S. action in the Dominican Republic, suggested increasing pressure on...yes, Berlin: '[The Soviet Minister of Defense, General Rodion Malinovskii] asserted that we should not be limited by anything we were already doing to help Vietnam, and that after the Dominican events we should expect action directed against Cuba. Thus we should actively counter the Americans. It was proposed that in the West (that is, in Berlin and on the border with Western Europe) a military demonstration should be carried out, and to send certain units--airborne forces and others--from our territory to Germany and to Hungary. He emphasized that we must be ready to strike West Berlin. Later, he added his own comment that "in general, in connection with the emerging situation, it follows that we do not fear approaching the risk of war."' Nichols, Tom (Professor of National Security Affairs at the Naval War College and a professor at the Harvard Extension School). "Five Close Calls With Death: How the Cold War Nearly Went Nuclear." Text. The National Interest. The Center for the National Interest, November 8, 2020.

<https://nationalinterest.org/blog/reboot/five-close-calls-death-how-cold-war-nearly-went-nuclear-172099>.

¹⁹⁵ "The US and Soviet Union made systemic, sustained assaults against each other along every azimuth except one: direct military attacks. This included economic warfare, information warfare, covert actions, and even proxy wars in Korea (where Soviet pilots flew covert missions against US forces), Vietnam (where Soviet soldiers manned air defenses that shot down dozens of American aircraft), Angola, and Afghanistan (where CIA-backed mujahideen covertly fought Soviet troops)." Allison, Graham. *Destined for War: Can America and China Escape Thucydides's Trap?* Houghton Mifflin Harcourt, 2017. In Chapter 9: Twelve Clues for Peace.



These examples suggest that the use of nuclear weapons is not inconceivable. High international tensions could spark a war in which nuclear weapons are used or heighten the risk that weapons are accidentally used after a false alarm or by mistake.

Would a nuclear exchange threaten the future?

An all-out nuclear exchange using the weapons available today would be an unprecedented catastrophe. The explosions, fires, and radiation could kill hundreds of millions of people.¹⁹⁶ Many more would likely suffer in the ensuing chaos: supply chains would be disrupted, global trade and communications networks would collapse, and critical infrastructure would be heavily disrupted.

Whether a nuclear war would be serious enough to threaten the long-term future, though, is controversial. Again, to pose such a threat an event must either cause the total extinction of humanity, an irrevocable civilizational collapse, or a permanent lock-in of sub-optimal values. There are several reasons to believe that a full nuclear exchange might not have the potential to cause such devastation. For example, there are few nuclear weapons in the southern hemisphere, and it is plausible that many countries in regions like South America and Africa would escape the brunt of the damage.

Instead, the tail-risk threat posed by nuclear weapons derives mainly from the chance they cause a nuclear winter. Such an event could be triggered if the fires set by nuclear explosions send enough smoke into the atmosphere to cause sustained global cooling, massively disrupting agricultural yields, perhaps for years. One study found that a full nuclear exchange between the US and Russia would produce so much smoke that global temperatures would drop by 8°C for four to five years, making food production impossible in most of the world.¹⁹⁷ Others argue that most people on Earth would starve as a result.¹⁹⁸

The concept of nuclear winter rose to prominence during the Cold War and proved controversial due to its apparent political implications. The findings of the most pessimistic

¹⁹⁶ Owen B. Toon, Alan Robock, and Richard P. Turco, “Environmental Consequences of Nuclear War,” vol. 1596, 1 (AIP Conference Proceedings, Washington, DC: American Institute of Physics, 2014), 38, <https://doi.org/10.1063/1.4876320>.<https://doi.org/10.1063/1.4876320> (quoted in Halstead, “Safeguarding the Future,” 34.).

¹⁹⁷ “According to one study, an all-out exchange between the US and Russia involving around 4,000 weapons in total would put vast amounts of smoke into the atmosphere causing a drop in global temperatures of around , making it impossible to grow food in most regions” Halstead, “Safeguarding the Future,” 35, citing Toon, Owen B., Alan Robock, and Richard P. Turco. “Environmental Consequences of Nuclear War.” *Physics Today* 61, no. 12 (December 1, 2008): 37–42. <https://doi.org/10.1063/1.3047679>.

¹⁹⁸ “Toon et al. (2014) arguing that this would “likely eliminate the majority of the human population”” Halstead, 35.



studies have been critiqued. In particular, the potential for adaptation seems large and understudied: food stockpiles could feed people for months, billions of standing livestock could be slaughtered and eaten, and people could eat more fish, mushrooms, and other foods that are less reliant on sunlight to grow. As a result, some experts think that even if a nuclear winter occurred, the risk of it causing extinction is low.¹⁹⁹ That said, whether or not civilization could recover from such an unprecedented and traumatic event is also unclear.

The steps leading from a nuclear exchange to a nuclear winter causing a civilizational catastrophe are shown in Figure 20. (The research and analysis for this section was done by Johannes Ackva, to whom we are grateful.)

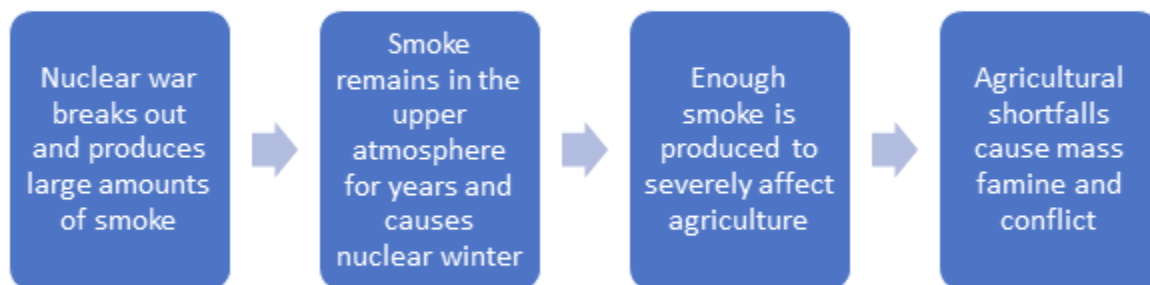


Figure 20: Nuclear pathways to famine and conflict

The first step in this chain concerns the amount of smoke a nuclear exchange sends into the atmosphere. There are three key variables to consider here. First, the scale of the nuclear war in terms of how many warheads are detonated matters. More detonations will set more fires and produce more smoke. Second, the targets of those warheads matter. Since cities have more flammable materials, bombs which strike urban areas (as opposed to rural targets, like military installations and missile silos) will produce more smoke. Third, whether or not the smoke produced reaches the upper atmosphere (e.g. altitudes of more than 12 kilometers) matters. At sufficiently high altitudes, the smoke would be unlikely to be washed out by weather, allowing it to cause long-term damage to the earth.

¹⁹⁹ “Some leading scientists working on nuclear winter have stated that the direct risk of complete extinction seems slim” Halstead, 36 citing Alan Robock, “Nuclear Winter,” *Wiley Interdisciplinary Reviews: Climate Change* 1, no. 3 (May 1, 2010): 421–22, <https://doi.org/10.1002/wcc.45>, 424; Carl Shulman, “Nuclear Winter and Human Extinction: Q&A with Luke Oman,” *Overcoming Bias*, accessed November 2, 2018, <http://www.overcomingbias.com/2012/11/nuclear-winter-and-humanextinction-qa-with-luke-oman.html>; Malcolm W. Browne, “Nuclear Winter Theorists Pull Back,” *The New York Times*, January 23, 1990, sec. Science, <https://www.nytimes.com/1990/01/23/science/nuclear-winter-theorists-pull-back.html>.



On this point there is considerable expert disagreement. For example, both Xia and Robock²⁰⁰ and Reisner et al.²⁰¹ present models estimating the amount of smoke generated by a “regional” nuclear war involving around 100 nuclear detonations. Their results for the amount of smoke that would reach the upper atmosphere vary from 22% to 98%. The amount of global cooling the models predict varies widely over this range.

The second step in this chain concerns how much global agricultural output suffers for a given level of smoke in the atmosphere. Again, the available evidence on this effect is sparse. Xia and Robock predict significant, though perhaps not catastrophic, shortfalls in production in the US and China; for example, a 20% rice production loss in China in the first four years after a nuclear war.²⁰² However, some aspects of this model seem likely to generate a high estimate. They assume that production methods do not adapt to the climatic changes and that infrastructure is damaged, preventing, for example, widespread crop irrigation.

The third step in this chain concerns how global food consumption is affected by agricultural shortfalls. Again, the available evidence makes it difficult to estimate what would happen if traditional agricultural yields fell short. A pessimist might predict further conflict due to panic, hoarding, and price shocks, perhaps even sparking further wars and further heightening global risk. Some analyses which try to extrapolate the effect on consumption from recent food price shocks predict serious effects, including export bans and price increases causing even more starvation in import-dependent countries than would be predicted by the production shortfall alone.²⁰³ However, the extent to which past food price shocks can be used to predict the effects of an event as catastrophic and unprecedented as a nuclear winter is debatable. In particular, if it were known that a price shock was temporary, speculators could bid up prices. Furthermore, one might expect that a nuclear exchange could plausibly lead to either greater cooperation between nations or an even more dramatic civilizational breakdown.

²⁰⁰ Lili Xia and Alan Robock, “Impacts of a Nuclear War in South Asia on Rice Production in Mainland China,” *Climatic Change* 116, no. 2 (2013): 357–72.

²⁰¹ Jon Reisner et al., “Climate Impact of a Regional Nuclear Weapons Exchange: An Improved Assessment Based On Detailed Source Calculations,” *Journal of Geophysical Research: Atmospheres* 123, no. 5 (March 16, 2018): 2752–72, <https://doi.org/10.1002/2017JD027331>.

²⁰² “We perturbed each year of the 30-year climate record with anomalies from each year of the 10-year nuclear war simulations for different regions in China. We found that rice production would decline by an average of 21% for the first four years after soot injection, and would slowly recover in the following years. For the next six years, the reduction in rice production was about 10%.” Xia and Robock, “Impacts of a Nuclear War in South Asia on Rice Production in Mainland China.”

²⁰³ “The number of people threatened by nuclear-war induced famine would be well over two billion.” Ira Helfand, “Nuclear Famine: Two Billion People at Risk?” (International Physicians for the Prevention of Nuclear War, November 2013), 2.



Another key uncertainty concerns how food consumption habits may adapt. Large groups of people could change what they eat to better survive in a world affected by nuclear winter. For example, it is currently estimated that only 6% of global dry biomass matter is consumed as food.²⁰⁴ What is currently lost in harvest or fed to livestock could instead be eaten by people if global food supplies suddenly and drastically shrank. People may also shift to eating foods that can be grown in colder conditions with less sunlight, such as fish and mushrooms.

Overall, it is difficult to predict the severity of a nuclear winter or the effects it would have on societal cohesion and human lives. Of course, this should not necessarily lead one to be less concerned; the uncertainty cuts both ways. It is particularly concerning that the models discussed by Xia and Robock and Reisner et al. consider an exchange of just 100 warheads. This is just 1% of the nuclear weapons in the world today; it is not difficult to imagine scenarios involving ten times as many bombs. Given the resilience of society and its capacity for adaptation, it may be difficult to imagine situations in which nuclear war directly leads to human extinction or an irreparable societal collapse. However, given the available evidence we cannot conclusively rule it out.

III. Subsequent disaster pathways

A war between Great Powers could also be a precursor risk that leaves humanity more vulnerable to subsequent disasters. The distinction between this category and the previous two categories is subtle. We distinguish it from direct risks by assuming that Great Power war is a precursor risk if the subsequent disasters are not caused by the war. For example, a Great Power war could leave humanity more vulnerable to climate change-related disasters, but climate change is not caused by the war. In contrast, nuclear winter would directly result from war. War as a precursor risk is also similar to conflict as a risk factor. The difference is that for Great Power war to be a precursor risk, war has to break out.

Here we consider two causal pathways. First, we consider the specific case in which, following the war, a global totalitarian hegemon emerges and “locks in” its values. We then consider a much broader class of other possible disasters, including natural events and climate change, that could impact a weakened humanity following a major war.

²⁰⁴ From Highlights: “Global agricultural dry biomass consumed as food is 6% (energy 9.0% and protein 7.6%).44% of harvested crops dry matter lost prior to human consumption. Highest loss rate in livestock production, but largest losses before harvest.”Peter Alexander et al., “Losses, Inefficiencies and Waste in the Global Food System,” *Agricultural Systems* 153 (May 1, 2017): 190–200, <https://doi.org/10.1016/j.agsy.2017.01.014>.



Causal Pathway 4: Totalitarian Lock-in

In the aftermath of wars, victorious states or coalitions are often able to impose their preferences or values on other states which have been defeated or left weakened by conflict. After defeating Napoleon for the final time at Waterloo, the five major powers of Europe agreed to cooperate to respect national borders and maintain the contemporary balance of power. The Concert of Europe, which involved Austria, France, Prussia, Russia, and the United Kingdom, shaped the map of Europe for about a century before collapsing with the outbreak of World War I. More recently, the United States was able to use its influence as the world's foremost military power after the end of World War II to develop and support a "distinctively open and loosely rule-based international order".²⁰⁵ The strength of this system helped entrench in many other countries American values and policies, including open markets, democracy, and participation in multilateral cooperation.

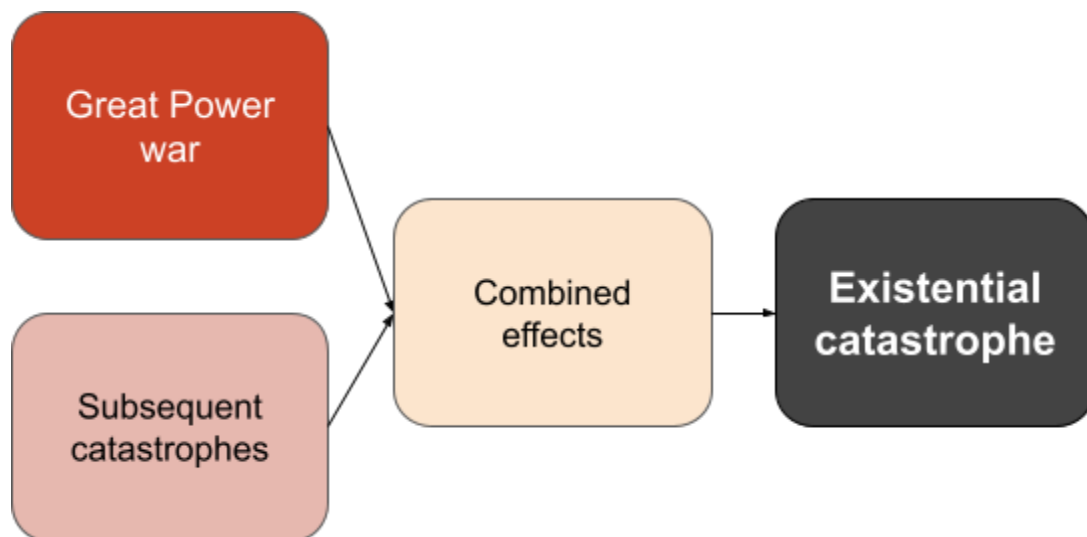


Figure 21: Multiple contributors to catastrophe

Since wars often drastically restructure the international order and hierarchy between

²⁰⁵ "The United States is not just a powerful state operating in a world of anarchy. It is a producer of world order. Over the decades, and with more support than resistance from other states, it has fashioned a distinctively open and loosely rule-based international order. This order – built with European and East Asian partners in the shadow of the Cold War and organized around open markets, security alliances, multilateral cooperation, and democratic community – has provided the foundation and operating logic for modern world politics. For better or worse, states in the postwar era have had to confront, operate in, or work around this far-flung order." G. J. Ikenberry, "Power and Liberal Order: America's Postwar World Order in Transition," *International Relations of the Asia-Pacific* 5, no. 2 (September 16, 2005): 133, <https://doi.org/10.1093/irap/lci112>.



Great Powers,²⁰⁶ one should worry about the aftermath of a future Great Power war even if the destruction caused in battle alone does not cause an existential catastrophe. In particular, it is plausible that, if a totalitarian state were victorious in a future Great Power war, it could use its advantage to entrench values so deeply and at such a large scale that they could not be dislodged (a scenario which may require technologies yet uninvented). In this scenario, even if humanity were to survive a war, the entrenchment of totalitarian values would preclude us from achieving our potential, constituting an existential catastrophe.

Previously, no state has been sufficiently dominant following a war to fully lock-in its values. After World War II, and especially after the collapse of the Soviet Union, the US was a global hegemon whose power exceeded that of all predecessors. Yet many other countries, whose culture and political systems are based on values other than the liberal democratic ones favoured by America, continue to survive. Moreover, the world now appears to be moving away from a situation in which the US is dominant.

Why should we worry that future hegemons will succeed where their predecessors have failed? To be sure, a lock-in severe enough to destroy humanity's potential would have to be extremely rigid. The controlling state would have to exercise complete control over the entire world, and fix this state of affairs such that it could never be changed. No state in the past has ever come close to achieving this. A modern superpower like the US can project its power globally; American interests include around 750 military bases in at least 80 countries around the world, allies on all continents, and supply chains that criss-cross the world.²⁰⁷ But the US is unable to spread its values to all corners of the earth and may not be interested in doing so.

If, in the future, a totalitarian government does gain the ability to bring the whole world under its control, it will be due to technological advances. Advances in weaponry and surveillance technologies may enable a sufficiently high degree of central control. Economist Bryan Caplan has argued that this would allow future totalitarian regimes to last

²⁰⁶ "In the modern age, the Thirty Years' War (1618–1648), the Napoleonic wars and the two world wars illustrate the point: in each case, what followed was a new international system, with a new distribution of territory, new political and economic arrangements, a new hierarchy between the great powers" Cesa, "Great Powers," 276.

²⁰⁷ "According to David Vine, professor of political anthropology at the American University in Washington, DC, the US had around 750 bases in at least 80 countries as of July 2021. The actual number may be even higher as not all data is published by the Pentagon. With 120 active bases, Japan has the highest number of US bases in the world followed by Germany with 119 and South Korea with 73." Haddad, Mohammed. "Infographic: History of US Interventions in the Past 70 Years." Accessed November 1, 2021. <https://www.aljazeera.com/news/2021/9/10/infographic-us-military-presence-around-the-world-interactive>.



much longer than they have been historically able to.²⁰⁸ Improved surveillance technology could allow future regimes to quickly identify and put down internal dissent, while advances in genetic engineering could allow them to engineer a docile population or greatly extend the lifespan of their leaders, reducing the instability introduced by succession problems. Totalitarian regimes also face an inherent trade-off between openness, which makes them susceptible to external ideological or economic influence, and closedness, which reduces their economic growth and makes it more difficult to compete with other countries. Future reductions in the number of countries would reduce the problems posed by this trade-off. Caplan concludes that there is no inherent reason that totalitarian regimes must end.²⁰⁹

Overall, this is a relatively indirect causal pathway from international tensions to existential catastrophe. Several things must go wrong for it to occur. First, international tensions must lead to a Great Power war of unprecedented destructiveness. Second, a totalitarian regime with global imperial ambitions must emerge from that war intact. Third, the totalitarian state must be sufficiently hegemonic to impose its values on the rest of the world, or at least cripple the ability of any remaining competitor states to rise to challenge its hegemony. Fourth, the totalitarian state must possess the technology to fully lock in its values and prevent them from being changed by successors or other leaders, as well as to control a potentially enormous global population to prevent internal revolt. Fifth, this situation must persist indefinitely.

Unfortunately, while such a sequence might seem unlikely, the historical trends discussed in this section suggest it would be premature to rule it out entirely.

Causal Pathway 5: Other subsequent disasters

Finally, it is plausible that a different disaster, normally survivable, would cause an existential catastrophe if it occurred following a major war. Such a disaster could be a naturally-occurring risk like a large asteroid or pandemic, or a human-caused disaster like a climate change or an engineered pandemic.

²⁰⁸ “On balance, totalitarianism could have been a lot more stable than it was, but also bumped into some fundamental difficulties. However, it is quite conceivable that technological and political changes will defuse these difficulties, greatly extending the lifespan of totalitarian regimes. Technologically, the great danger is anything that helps solve the problem of succession. Politically, the great danger is movement in the direction of world government.” Bryan Caplan, “The Totalitarian Threat,” in *Global Catastrophic Risks* (Oxford University Press, 2008), 510, <https://doi.org/10.1093/oso/9780198570509.003.0029>.

²⁰⁹ “The deep question, however, is whether this short duration was inherent or accidental. [...] Thus, a totalitarian regime that tried to preserve itself by turning inwards could probably increase its life expectancy.” Caplan, 508.



Such a confluence of events seems unlikely for several reasons. First, naturally-occurring risks are much less probable than the riskiest human-caused disasters. In *The Precipice*, Toby Ord estimates that the total risk from human-caused disasters, at least for the next century, is multiple orders of magnitude higher than the total risk from natural disasters.²¹⁰ Second, if any significant fraction of the species survives the war, humanity may prove quite resilient. This is because the survivors might be found in many different groups spread across the globe. If just one group survives, it could eventually repopulate the Earth and recover civilization. Analysis by Luisa Rodriguez has found that even if 99.9% of humanity were wiped out, leaving just 8 million survivors, the probability of human extinction is low.²¹¹ For the scenarios Rodriguez analyzes, the risk of extinction rises above 0.1% only when she assumes each group has a 99% chance of being killed *and* there are 80 groups or fewer, *or* each group has a 90% chance of being wiped out *and* there are 8 groups or fewer.²¹²

Still, in other plausible scenarios subsequent catastrophes could prove a considerable danger to humanity following a major war. For example, if such a war occurs decades in the future and climate change proves to be a serious problem, then humanity may struggle to recover without using cheap fossil fuels and risking extreme climate change scenarios. Taken together, this kind of scenario, a scenario of unrecoverable collapse, and potential for other, unforeseen risks are sufficiently plausible to merit inclusion in this model.

Summary of pathways to catastrophe

Combining each of the five above pathways generates the following causal diagram:

²¹⁰ “One of the most striking features of this risk landscape is how widely the probabilities vary between different risks. Some are a million times more likely than others, and few share even the same order of magnitude. This variation occurs between the classes of risk too: I estimate anthropogenic risks to be more than 1,000 times more likely than natural risks. And within anthropogenic risks, I estimate the risks from future technologies to be roughly 100 times larger than those of existing ones, giving a substantial escalation in risk from Chapter 3 to 4 to 5.” Ord, *The Precipice: Existential Risk and the Future of Humanity*.

²¹¹ “With 8 million survivors, even extremely pessimistic views of the likelihood that any one group gets wiped out don’t necessarily lead to high probabilities for extinction in most scenarios” Luisa Rodriguez, “What Is the Likelihood That Civilizational Collapse Would Directly Lead to Human Extinction (within Decades)?,” December 24, 2020, <https://forum.effectivealtruism.org/posts/GsjmufaeibreaivF7/what-is-the-likelihood-that-civilizational-collapse-would>.

²¹² “Even if you thought any one group of 100 or 1,000 survivors had a 99% chance of being wiped out (by failing to feed itself, to find water, to survive natural shocks), it would still be virtually guaranteed that at least one group of survivors would survive. If you thought there was a 99% chance that each one of 800 groups of 10,000 people would be wiped out, there would still only be a 1 in 3,000 chance of extinction.” Rodriguez, “What Is the Likelihood That Civilizational Collapse Would Directly Lead to Human Extinction (within Decades)?”

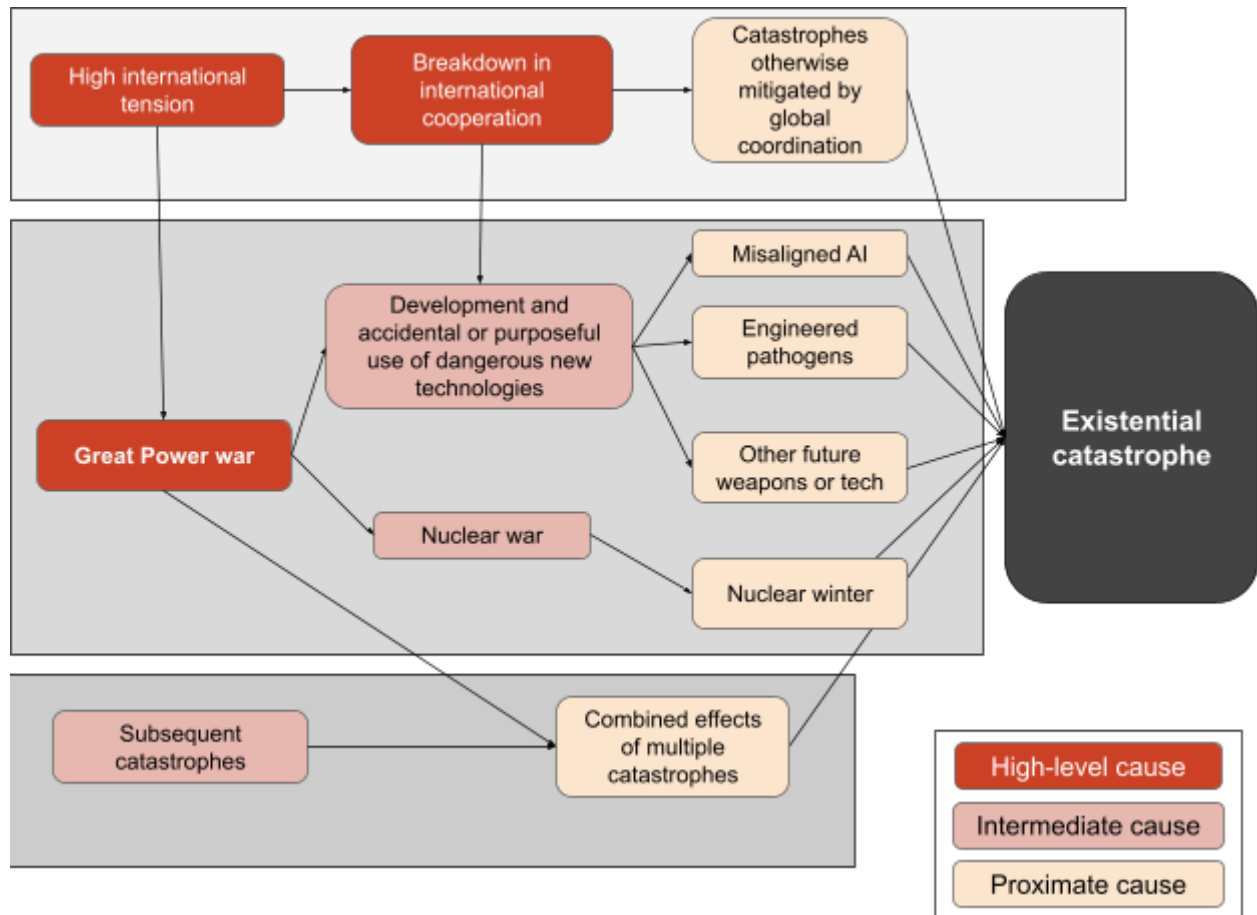


Figure 22: Pathways to catastrophe

We have also [translated this model to Guesstimate](#) with rough guesses for the conditional probabilities leading between the nodes in the diagram. For clarity we have opted for point estimates of most probabilities. An important direction for future research is to generate a more robust estimate using reasonable confidence intervals around each parameter in the diagram. The exception to this is the “International Tension” node. Unlike the other nodes in the diagram, we conceptualize international tension as a continuous variable with a range of $[0, 1]$ rather than a binary variable. In other words, there can be more or less international tension depending on how good relations between the Great Powers are. When relations are better, the International Tension variable takes on a value closer to 0. Recall that we defined international tension as a shared worry of an imminent conflict. For this diagram, therefore, we can also conceptualize international tension as the probability a Great Power country would assign to war breaking out over a given time period (in this case, the next 100 years).



One can imagine that in the 1990s, for example, when the risk of Great Power conflict seemed very low, this variable would have been close to 0. In contrast, in the lead-up to World War I, or during the Cuban Missile Crisis, this variable would have been closer to 1. Following our concluding estimates of the risk of Great Power war over the next 100 years in section 3, here we set the International Tension variable to be between 0.1 and 0.4.

We can look for some corroboration of this model by comparing it to Toby Ord's estimate of the risk posed by Great Power war from *The Precipice*. There, Ord guesses that, if one could guarantee that the Great Powers would not go to war in the next 100 years, "an appreciable fraction [of the total existential risk] would disappear—something like a tenth of the existential risk over that time" (though he also notes that "it is impossible to be precise").²¹³ Since Ord estimates the probability of an existential catastrophe in the next 100 years is approximately 1 in 6, or 17%, we might assume that he thinks the risk from war is around 2%. This estimate does not seem to account for the effect of international tension more generally. Therefore the total risk across all the pathways in Figure 22 would be somewhat higher. Our model is roughly in line with this, estimating a total probability of 2.5%. While it does not seem crucial that our estimate lines up with Ord's, it is interesting that they are relatively close.

Which pathways seem most concerning? The Guesstimate model shows that the overwhelming amount of the risk—over 95% of the total—flows through pathways 1 and 2, the pathways related to international cooperation and technological risks. This is mainly because the conditional probabilities connecting the nodes—the chances that if one thing happens, the next step in the causal chain will also happen—are much higher. By contrast, the risks of something like nuclear winter or a totalitarian lock-in, while non-zero, rely on several improbable steps.

Assumptions and limitations of this model

We recognize that the above model has several important limitations.

First, although we model the pathways as linear, in reality there are complex feedback loops between the different nodes in the model. For example, while it seems relatively unlikely that a Great Power war would directly lead to extinction, it seems very likely that such a war would make subsequent international cooperation much more difficult. We have not modelled this pathway above. A positive feedback loop between technological development and international tension also seems plausible: higher international tensions

²¹³ In Chapter 6: The Risk Landscape. Ord, *The Precipice: Existential Risk and the Future of Humanity*.



drive Great Powers to speed up their technological development, while technological arms races raise international tensions.

Second, there are probably other pathways that we have not identified, and more pathways may emerge in the coming years.

Third, the probabilities we assign to the steps in the causal pathways have a large effect on the final estimates, but are not strongly based in evidence. A deeper analysis would very likely change the conditional probabilities. This could change the ranking of the causal paths by probability. Because the probabilities of the pathways range over more than one order of magnitude, though, the changes to the conditional probabilities would have to be very large to make a difference.

Fourth, one can imagine second- and third-order effects of international tension and conflict that create even more indirect pathways to catastrophe.

Despite these limitations, we hope that by attempting to make the causal pathways more concrete, the model can help make discussions about the relationship between Great Power conflict and the long-term future more productive.

In the next section, we turn to the evidence on what, if anything, can be done to reduce these risks.



Evaluating interventions

Having reviewed what we know about the causes of war and the future of Great Power conflict, we can now turn to the question of what, if anything, philanthropists can do to reduce these risks.

Our causal pathways diagram suggests several points where one could intervene to affect the probability of a global catastrophe resulting from international tension. One could work on the top-level node, the level of tension between Great Power states. Or one could work on one of the causal connections between the top-level node and the intermediate nodes along the pathway to catastrophe.

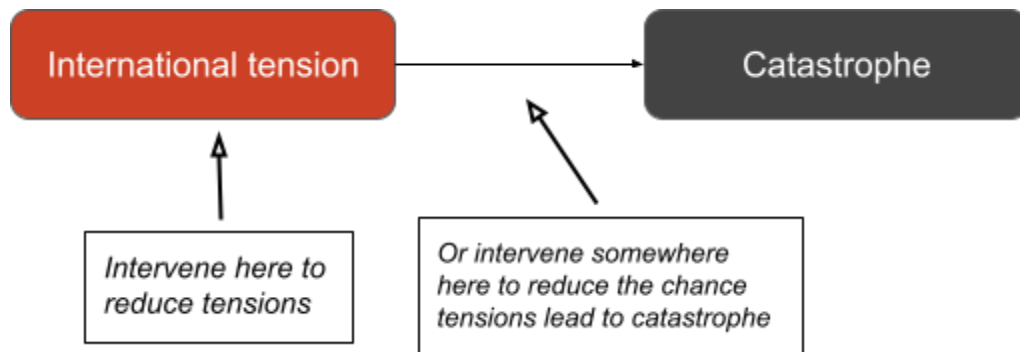


Figure 23: Intervening to prevent catastrophe

There are two top-level nodes and 18 probabilistic connections in Figure 22, the causal pathways diagram described previously. This is too many to consider here. In line with the scope of this report, which focuses on Great Power conflict and cooperation, we only consider interventions which address the following issues:

1. Reducing the amount of tension between Great Power states
2. Reducing the chance that a given level of tension leads to war
3. Reducing the chance that a given level of tension causes a breakdown in international cooperation

These pathways are not necessarily the most important or most tractable. Several of the specific pathways from war to existential catastrophe are covered in some depth in our report on Safeguarding the Future (albeit without specific reference to Great Power conflict). How possibilities for working on these different nodes compare to each other is discussed briefly below, in our section on funding opportunities.



Expected value, upside, and downside

Sources of uncertainty about impact

We will have lots of uncertainty about the effect of our actions in this space. There are three main challenges to assessing the effectiveness of funding opportunities in this space: uncertainty about the costs and benefits of specific policies, uncertainty about the influence of specific organizations, and uncertainty about the effects of marginal funding.

First, the net benefits and costs of specific policies are often debated by experts and difficult to assess empirically. As we have seen in earlier sections, there remain many open questions in the field of international relations. These include such fundamental issues as the conditions under which deterrence is effective, the importance of psychological biases and social contexts for the decision-making of national leaders, and the effect of more trade, economic growth, and international organizations on the incidence of war.

Second, even when we are relatively confident that the expected benefits of a specific policy outweigh its expected costs, untangling the influence of a given organization in getting that policy implemented is a distinct challenge. Multiple organizations may be involved in lobbying for the same policy, or it may be the case that a policy would have been implemented whether or not an organization was lobbying for it or providing implementation support. This makes assessing the counterfactual influence of a policy organization—its impact in comparison to a hypothetical world where it was not involved—especially difficult.²¹⁴

Third, we are often uncertain about how marginal donations change an organization's actions. A donation's counterfactual impact may be lower than anticipated if other donors react by giving less, knowing that the organization will be funded anyway. Organizations may react to restricted donations to one programme by shifting other funds to a second programme, so that the counterfactual impact of the restricted donation is actually to increase funds to the second programme. These concerns about the *additionality* of donations—whether they actually increase a charity's output relative to the counterfactual scenario—are not unique to policy organizations, but are important for any donor to consider.

²¹⁴ For more on this challenge, see: John Halstead, "Evaluating Policy Organizations," accessed October 12, 2021, <https://founderspledge.com/research/fp-evaluating-policy>.



Expected value reasoning

High uncertainty makes identifying impactful interventions and funding opportunities more difficult, but not impossible. Often interventions with uncertain effects can be justified as impactful in expectation if they have high upside. For example, policy advocacy efforts may have a large chance of having no effect, but a small chance of a large, positive effect if successful. If we assume the policy has positive effects if implemented, the distribution of the advocacy's impact would look something like this:

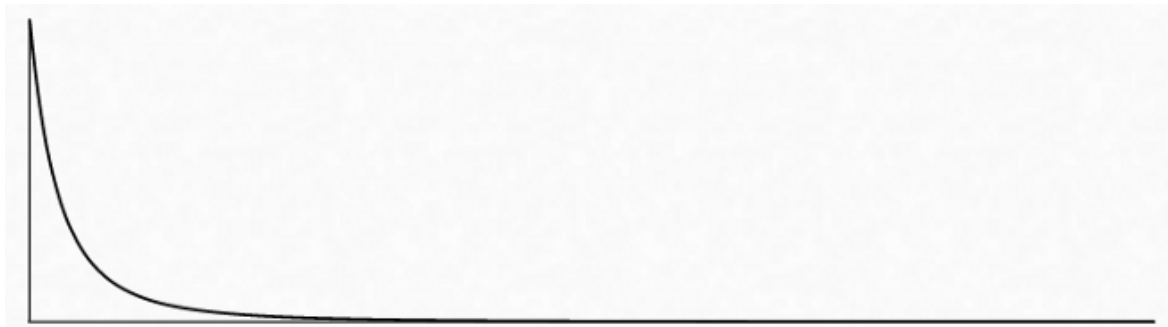


Figure 24: A Pareto distribution

The above is a Pareto distribution. If we assume it's been generated by multiplying the impact of the policy by our probability distribution of the advocacy being successful, then the expected impact is on the x-axis and the probability of realizing it is on the y-axis. The distribution peaks where $x = 0$. In other words, the most likely outcome is that the policy advocacy has no impact. However the distribution has a long tail: there's a small chance that x is much greater than 0. Were we to calculate our total expected impact by multiplying the total value by the probability we attain it, then we would find that the action of funding this policy advocacy is positive on average, even though the most likely outcome is that it has no success. Another way of interpreting this is that if we funded a sufficiently-large portfolio of actions like this, we would expect at least some to be successful, and our average impact per grant would be close to the average expected impact of the grants, weighted by grant size.

However, we made a strong assumption in the above case: we assumed the policy would have positive effects if implemented. In reality, in addition to uncertainty about our ability to implement certain policies, we are likely to have some uncertainty about the effects of those policies once implemented. When it comes to foreign policy, we may even be uncertain whether a given policy is likely to be beneficial or harmful. For example, while some researchers think deterrence policies prevent wars by making them more costly to fight, others think that they are likely to spark conflict spirals that make wars more likely. There are similar disagreements over the effects of policies like appeasement and moves to



increase economic interdependence. That means that the distribution of possible benefits from our policy advocacy might look something more like this:

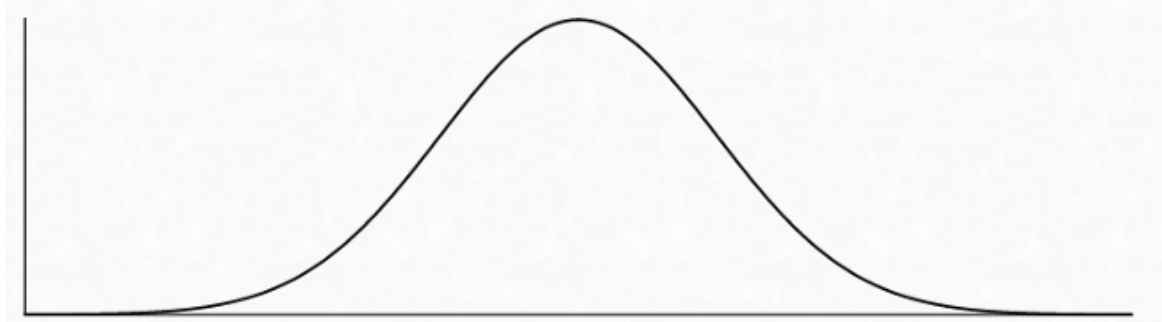


Figure 25: A normal distribution

Fortunately, rarely will our uncertainty about the effects of a policy being perfectly symmetrical around 0. The balance of the evidence will usually shift the distribution. So this does not mean that our uncertainty leaves us unable to reason about which interventions to prioritize in complex cause areas like this one. But it does mean that we cannot simply assume that any chance of successfully getting a policy implemented makes the value of policy advocacy positive in expectation. If there's some chance the policy could be harmful, then the value of advocacy may be very small (or even negative). And for interventions that seek to influence global catastrophic risks like Great Power war, the stakes are high. So it's especially important to be cognizant of the downside risks and cautious about what we fund.

Assessing interventions

So how can we assess different possibilities to determine which approaches are most promising? Here we combine three main approaches.

First, where such data is available, we can use direct impact evaluations. It is usually impossible to collect experimental evidence of the effectiveness of different interventions in this space. But literature reviews, case studies, and quasi-experimental methods like regression analyses on observational data have been used to assess the effectiveness of interventions like Track II diplomacy. Organizational impact evaluations can also be used to measure intervention effectiveness.

Still, because it is impossible to run experiments and generate large sample sizes, the impact of specific policies will often be uncertain and it will be difficult to tell which organizations, if any, were instrumental in bringing a specific policy outcome to fruition.



Given this, we will also usually need to use heuristics, or processes that approximate an impact evaluation, to assess interventions. One option is to prioritize interventions which experts generally agree are impactful to support. Another is to use an existing framework. For example, when direct evidence of effectiveness is lacking, the ITN framework, which assesses interventions based on their Importance, Tractability, and Neglectedness, is commonly applied.²¹⁵ Here, interventions are roughly ranked based on how *important* they are in terms of the size of the problem they aim to solve, how *tractable* they are in terms of how much additional funding would help solve the problem, and how *neglected* they are based on how much funding they currently receive. While it is almost always preferable to have direct evidence of a specific intervention's cost-effectiveness,²¹⁶ the ITN framework can be a useful tool to get a rough sense when such evidence is lacking.

Finally, where we still have high uncertainty after examining all the available evidence, we can prioritize interventions that have high upside and low downside (i.e. which have some chance of bringing about a very good outcome, and low or no chance of causing harm).

That leaves us with three broad questions to ask when assessing an intervention in this space:

1. Is there direct evidence of its effectiveness?
2. Do heuristics, such as the ITN framework or expert consensus, suggest the intervention is likely to be cost-effective?
3. Does the intervention seem to have high upside and low downside risk?

Earlier sections of this report assessed the importance of Great Power war in terms of the probability of conflict this century and its effects on the long-term future. Here we focus on Tractability and Neglectedness to understand how effectively interventions can reduce that risk.

²¹⁵ For more on this framework, see: "ITN Framework - EA Forum," accessed October 12, 2021, <https://forum.effectivealtruism.org/tag/itn-framework-1>.

²¹⁶ "Marginal cost-effectiveness is what we ultimately care about. If we can estimate the marginal cost-effectiveness of work on a cause without estimating the total scale of a problem or its neglectedness, then we should do that, in order to save time. Marginal cost-effectiveness analysis does not require the assumption of diminishing marginal returns, which may not characterise all problems." John Halstead, "The ITN Framework, Cost-Effectiveness, and Cause Prioritisation," *EA Forum*, October 6, 2019, <https://forum.effectivealtruism.org/posts/Eav7tedvX96Gk2uKE/the-itn-framework-cost-effectiveness-and-cause>.



Tractability: Potential risk reduction

To assess the tractability of Great Power war interventions, we have to estimate how much of the risk discussed previously is influenceable. "Influenceable risk" here refers to the amount of risk posed by Great Power war that could be reduced if one were able to make huge investments in effective interventions.

In section 3, we discussed several different estimates of the risk of Great Power war this century. Our overall estimate of the risk of a major conflict breaking out in the next 100 years was about 30%. If we assume for simplicity that the risk is evenly distributed throughout the century, that works out to roughly 0.35% chance of conflict per year.

There are a few reasons to think that at least some of this is influenceable. First, because the frequency of conflicts has varied over time, we can infer that it is sensitive to political, cultural, social, and economic factors. It is not simply a coincidence that there has not been a major war since WWII. While it has proven very difficult to identify the actual factors that allowed the US and the Soviet Union to avoid direct conflict, the fact that they were able to do so shows that it is possible to maintain peace even in times of heated international rivalry. Perhaps policy decisions like the Moscow-Washington hotline contributed to this outcome. The hotline, which allowed for direct, reliable communication between top policymakers in the US and the Soviet Union to facilitate conflict management, was established following the Cuban Missile Crisis and promoted by researchers like Thomas Schelling.²¹⁷ This example suggests that gaining a better understanding of good policies and interventions, and pushing for their implementation, can meaningfully reduce the chance a war occurs.

Still, it remains difficult to say what proportion of the total risk is influenceable. One approach is to speculate about the effect a massive philanthropic effort in this space could have. Imagine a program of \$1 billion per year being spent in this space. This would represent a tenfold increase in philanthropic effort (see following section): 10 times as much philanthropically-funded research into policy-relevant questions, 10 times as many Track II dialogues, 10 times as many op-eds and events hosted by think tanks and advocacy groups to build grassroots support for peaceful policies. A conservative estimate might be that this would reduce the annual risk of a war by something like 1 in 20. An optimistic estimate could be even higher, perhaps closer to 1 in 3.

²¹⁷ "Several people came up with the idea for a hotline. They included Harvard professor Thomas Schelling, who had worked on nuclear war policy for the Defense Department previously. [...] The 1962 Cuban Missile Crisis made the hotline a priority. During the standoff, official diplomatic messages typically took six hours to deliver; unofficial channels, such as via television network correspondents, had to be used too as they were quicker." "Moscow–Washington Hotline," in *Wikipedia*, September 18, 2021, https://en.wikipedia.org/w/index.php?title=Moscow%E2%80%93Washington_hotline&oldid=1045047820.



To give an idea of what might be at stake, we calculate on the basis of a toy model using some plausible-seeming numbers. Taking the median of the two above estimates, we can calculate how much this effort would reduce the total chance of a war breaking out in the next 100 years. If we assume that 5% of the time such a war occurs it leads to an existential catastrophe, we can also calculate the effect of the philanthropic effort on reducing the risk of catastrophe. Here, we assume that interventions do not reduce the probability of a catastrophe given a war breaks out and only look at the supposed effect on the risk of war itself. These calculations are shown in Table 5 below. (Remember that this is the total risk reduction for a massive increase in philanthropic effort, not an estimate of the marginal risk reduction)

Table 5: Toy model of intervention to reduce Great Power conflict risk	
Constants	
Time horizon (years)	100
Baseline scenario	
Annual risk of war	0.0035
Chance of existential catastrophe given war	5%
Baseline chance of peace (100 years)	70%
Baseline risk of war (100 year)	30%
Intervention: massive effort to reduce risk of conflict (upper bound)	
Proportional annual risk reduction	0.33
Proportional reduction in chance of catastrophe	0
Intervention chance of peace (100 years)	79%
Intervention risk of war (100 years)	21%
Reduction in probability of war	9%
Reduction in probability of existential catastrophe	0.4%
Intervention: massive effort to reduce risk of conflict (lower bound)	
Proportional annual risk reduction	0.05



Proportional reduction in chance of catastrophe	0
Intervention chance of peace (100 years)	72%
Intervention risk of war (100 years)	28%
Reduction in probability of war	1%
Reduction in probability of catastrophe	0.1%
Median reduction in probability of war	5%
Median reduction in probability of catastrophe	0.2%

The next step would be to estimate how much of this risk reduction could be achieved, in expectation, by the marginal funding opportunity, given our current level of knowledge. We will cover this later on, after reviewing the candidates for potential intervention.

Funding landscape

Neglectedness is a key part of the ITN framework because, all else equal, interventions that currently receive less attention from other funders are more likely to be cost-effective at the current margin. We can quantify neglectedness on two levels. First, for inter-cause comparisons, we can consider how neglected efforts to reduce the risks of Great Power war are compared to other existential risks and risk factors. Then, within the cause of Great Power war, we can identify specific interventions that are more neglected than others.

Prior to looking at any data about funding, we might expect Great Power war to be a relatively crowded cause area. Wars are negative-sum games. While some combatants may lose more than others, or even emerge as relative winners, on net society is left worse off after wars occur. Wars are also risky and unpredictable for all participants. We have seen that there are many reasons why wars continue to occur despite these costs. However, in general governments and citizens would prefer not to make risky, costly gambles. Unless there are serious coordination failures, we might expect societies to already devote significant resources towards understanding and preventing wars.

On the other hand, such coordination failures are common. Societies can and do fail to allocate resources to the most important problems for a number of reasons. In some cases, the policymakers in charge of allocating public funding may not be incentivized to support the most important or impactful things. Public officials work on the time-scale of electoral cycles, which may be too short to effectively realize the benefits of positive changes in foreign policy. Voters may be poorly informed about foreign policy issues. The Cold War ended over 30 years ago. No Great Powers have come into direct conflict since World War II,



or since the 1950s if one counts China as having been a Great Power at that time. Voters do not rank Great Power conflict as a highly important issue.²¹⁸ And there are intergenerational externality problems: the long-term effects of catastrophic wars or Great Power competition later in the 21st century impose costs on future generations who do not vote in elections and are not currently represented in the vast majority of policymaking institutions.

So the neglectedness of efforts to reduce the risk of Great Power conflict is unclear from prior considerations; we have to actually look at the data on public and private funding.

Government funding

As one might expect, governments do spend a lot on diplomacy and foreign policy. The US State Department alone spends about \$9 billion annually on diplomatic programs across 195 countries. Its 2020 Congressional Budget Justification includes requests for \$1.5 billion for Overseas Programs and \$817 million for Diplomatic Policy and Support functions. The budgets for more specific and relevant programs are much smaller, but still large in comparison to a typical think tank or research institute. For example, the State Department requested:

- ~\$15 million for International Security and Nonproliferation, which includes “multilateral diplomacy activities that are critical to preventing the proliferation of weapons of mass destruction, associated delivery systems”²¹⁹
- \$4 million for the Nonproliferation and Disarmament Fund, which “develops, negotiates, and implements carefully-vetted projects to destroy, secure, or prevent the proliferation of WMD and related materials and delivery systems, and destabilizing conventional weapons”²²⁰
- \$18 million for a Cyberspace Security and Emerging Technologies division, which will “support foreign policies and initiatives to promote U.S. cyber and emerging technology policies and deter adversaries from malicious and destabilizing behavior in their use and application of such technologies”²²¹

²¹⁸ “Foreign policy” ranks sixth on a list of issues sorted by the percent of registered US voters saying an issue is “very important” to them for the 2020 election. “Important Issues in the 2020 Election,” Pew Research Center, August 13, 2020,

<https://www.pewresearch.org/politics/2020/08/13/important-issues-in-the-2020-election/>.

²¹⁹ “Congressional Budget Justification: Department of State, Foreign Operations, and Related Programs - Fiscal Year 2021” (United States Department of State, February 2020), 13.

²²⁰ “Congressional Budget Justification,” 11.

²²¹ “Congressional Budget Justification,” 11.



One takeaway from the above numbers is that the large total amount of public funding for diplomacy and foreign policy is split across so many different areas that specific issues could still be considered neglected despite the size of the overall budget. The \$18 million budget for the Cyberspace and Emerging Technologies division, for example, is roughly equivalent to a large think tank's. For reference, in 2020 the Brookings Institution spent \$18M on "Foreign Policy Studies."²²² And one might also question the average effectiveness of the public budget.

Outside of the State Department, the US also provides public funding for research initiatives in public bodies, think tanks, and universities. For example, the National Science Foundation has a program for Security and Preparedness,²²³ but we could not easily find public research funding data for specific programs.

We have so far discussed just US government spending. Other governments also have large budgets for diplomacy and foreign policy. Even if we assume that the US, due to its international standing, spends twice as much on diplomacy than other countries as a proportion of its GDP, total diplomatic spending would likely exceed \$30 billion annually. Among Great Powers, it likely exceeds \$15 billion.

Because governments spend so much in absolute terms on diplomacy and foreign policy, the questions of how efficient this spending is, and whether there are issues that remain neglected, are highly important. We look into these in more detail below.

Multilaterals

In addition to national governments, a large amount of the available public funding for peace and diplomacy is allocated by multilateral organizations. Preventing conflict was central to the original mission of the United Nations, which was founded in part to facilitate "preventive diplomacy" and avoid wars between member states.²²⁴ The U.N.'s peacekeeping budget has grown over time and today totals more than \$6 billion per year.²²⁵ However, these efforts are largely focused on regional or civil wars rather than direct conflict

²²² "The Brookings Institution and Affiliates: Consolidated Financial Report," June 30, 2020, 6, <https://www.brookings.edu/wp-content/uploads/2021/02/2020-audited-financials.pdf>.

²²³ "Security and Preparedness (SAP)," Beta site for NSF - National Science Foundation, accessed October 12, 2021, <https://beta.nsf.gov/funding/opportunities/security-and-preparedness-sap>.

²²⁴ "Conflict prevention is a central feature of the United Nations Charter" (Ackerman 2003, p. 340)

²²⁵ "The United Nations currently operates 13 U.N. peacekeeping missions worldwide, with more than 80,000 military, police, and civilian personnel from over 100 countries. [...] The total approved budget for the 2020-2021 peacekeeping year is \$6.58 billion" (Congressional Research Service, "United Nations Issues: U.S. Funding of U.N. Peacekeeping", <https://fas.org/sgp/crs/row/IF10597.pdf>)



between Great Powers.²²⁶ Other multilateral functions, like providing fora for dialogue and conflict resolution in the General Assembly and the Security Council, are more plausibly relevant to reducing the risk of conflict between Great Powers. There are also alliances like the North Atlantic Treaty Organisation (NATO), which provide fora for dialogue and coordination.

Philanthropic funding

The [Peace and Security Funders Index](#) tracks global spending by philanthropists on issues of conflict and international cooperation. Their database is reasonably comprehensive. It encompasses grants from the major funders in this space, which include the Carnegie Corporation of New York, the John D. and Catherine T. MacArthur Foundation (“MacArthur Foundation”), and the Charles Koch Institute. It’s worth noting that, because some funders report their activities to the Peace and Security Funders Group more quickly than others, the most recent version may not be complete.

Total spending by all funders included in the Index was \$377M in 2018 (complete data for more recent years are not available). This funding, which amounted to less than 0.5% of total giving by foundations,²²⁷ was distributed across a range of issues. These include efforts related to Great Power peace and cooperation, but also regional peacebuilding in fragile and conflict-affected states, gender-based violence, accountability and transparency, and international and regional organizations. Funding totals for the three main categories in the PSFI for 2018 are presented below:

Table 6: Total funding for major areas, PSFI 2018 ²²⁸		
Issue	Total funding (million \$)	Percent of total*
Preventing and mitigating conflict	130	34.5
Resolving conflict and building peace	113.8	30.2

²²⁶ Bertrand G. Ramcharan, “Preventive Diplomacy at the United Nations,” United Nations (United Nations), accessed June 3, 2021, <https://www.un.org/en/chronicle/article/preventive-diplomacy-united-nations>.

²²⁷ American foundations alone gave more than \$70B in 2019. See: “Giving USA 2020: Charitable Giving Showed Solid Growth, Climbing to \$449.64 Billion in 2019, One of the Highest Years for Giving on Record,” Giving USA, June 16, 2020, <https://givingusa.org/giving-usa-2020-charitable-giving-showed-solid-growth-climbing-to-449-64-billion-in-2019-one-of-the-highest-years-for-giving-on-record/>.

²²⁸ “Peace and Security Funding Index,” 2020, <https://www.issueclab.org/resources/37788/37788.pdf>.



Supporting stable, resilient societies	211.6	56.2
* total does not add up to 100% because some grants are counted in multiple categories		

Based on the issues included in each category, the “Preventing and mitigating conflict” category is most relevant to this report.²²⁹ “Resolving conflict and building peace” is largely related to resolving regional conflicts, while “supporting stable, resilient societies” relates mainly to human rights and governance issues.²³⁰

Within the Preventing and mitigating conflict category, 78% of the total funding goes to nuclear issues (\$52M), conflict and atrocities prevention (\$35M), and cybersecurity (\$15M). “Weapons” and “Militarism” received less than \$10M total.

It is difficult to draw strong conclusions without more detail about the grants in each category. However these data at least suggest that philanthropic funding for Great Power cooperation and conflict prevention currently is probably on the order of \$50 million per year. Nuclear issues are better funded than other issues in the category of conflict prevention. Conflict prevention and diplomacy initiatives received at most \$64 million in 2018, and likely much less because other issues also fall in the same category. Emerging technologies are absent from the Index’s categorization. They may fall in the “Weapons” category, in which case they received at most \$7.4 million in 2018.

Funding landscape summary

Government budgets for diplomacy are very large: on the order of \$10 billion in the US alone. However, only a fraction of this is spent on programs that are specific to Great Power diplomacy or preventing wars.

Philanthropic spending on Great Power conflict and cooperation is relatively low: very likely under \$100 million per year and likely on the order of \$50 million per year.

²²⁹ Included in this category are: conflict and atrocities preventions; countering violent extremism and counter-terrorism; cybersecurity; gender-based violence; militarism; nuclear issues; and weapons.

²³⁰ Included under “Resolving Conflict and Building Peace” are: conflict resolution; demobilization, disarmament, and reintegration; migration; peace negotiations; peacebuilding; and transitional justice. Included under “Supporting Stable, Resilient Societies” are: accountability and transparency; climate security and natural resource management; democracy-building; gender equality; international and regional institutions; international development; national security, foreign policy, and diplomacy; and rule of law and institution building.



For comparison, funding for conflict prevention and stabilization programmes in lower income countries is at least five times greater than this, according to data from the Peace and Security Funders Index.

Candidate interventions

While it is useful to have a sense of which areas are more neglected than others, ideally we will be able to directly assess the effectiveness of interventions in order to prioritize among them. In this section we review what evidence is available on five different approaches a philanthropist might take: field building, research, policy advocacy, and non-official (Track 1.5 and Track II) diplomacy.

Field building

Data from the Peace and Security Funders Index indicate that relatively few funders and institutions support IR research and policy advocacy that is highly relevant for those concerned with humanity's long-term future (hereafter "longtermists"). A few examples of this apparent neglect include:

- Of the major think tanks, few have programs related to Great Power conflict. We examined 14 potential think tank funding opportunities for this report, sourced after speaking to experts, reading reports, and conducting Google searches. Of these, 11 (78%) have programs related to Great Power relations, but only 2 (14%) mention catastrophic risks or longtermism.²³¹
- Only 35% of the funding from Peace and Security Funders Group members in 2016 went to Preventing and Mitigating conflict. Since this category includes grants related to atrocities prevention, cybersecurity, counter-terrorism, and gender-based violence, funding for preventing Great Power conflict, technological disasters, and other global catastrophic risks seems likely to be on the order of 10-15% of total peace and security funding
- There is much more funding for nuclear weapons issues (~\$50M in 2016) than emerging technologies (<\$25M, and <\$10M if we exclude cybersecurity), though emerging technologies arguably pose significantly more risk. (An important caveat here is that the Macarthur Foundation is phasing out its nuclear security funding, so this funding distribution is likely to change.)²³²

²³¹ Koji Flynn-Do did the research and analysis for this. For details, see "Think Tank Classification" https://docs.google.com/spreadsheets/d/1nURcw1Ph3UUBZV_4BaUh_wvNwciRTfuKO6u8YK1FDK0/edit#gid=0

²³² Bryan Bender, "'A Big Blow': Washington's Arms Controllers Brace for Loss of Their Biggest Backer," POLITICO, July 19, 2021, <https://www.politico.com/news/2021/07/19/washington-arms-controllers-nuclear-weapons-500126>.



- The Carnegie-Tsinghua Center for Global Policy is one of only two international think tanks based in China, and the only one that analyzes foreign policy.²³³

These observations suggest that fewer think tanks focus on Great Power relations or catastrophic risks than the importance of these topics might warrant. However, there may be good reasons for this. The importance of Great Power relations, for example, may cause governments to invest more in studying them, or may mean independent bodies have fewer opportunities to influence policy.

A field-building effort around Great Power relations and longtermism would require starting new research centers or expanding existing ones with explicitly longtermist mandates. It would involve supporting researchers with relevant interests, training new researchers, and building support among policymakers and voters for reducing global risks. The open research questions these institutions could address are explored in the next section.

Field-building could also include supporting grassroots organizations that try to encourage support for peaceful foreign policy among voters. Some organizations attempt to do this by raising awareness or supporting community groups such as veteran associations. However, we have not looked into this intervention in depth.

All that said, field-building requires large amounts of capital and long-term commitments, which means it is likely not the optimal intervention for individual donors to consider in this space.

Research

In line with, and perhaps because of, the lack of longtermist IR field-building, IR research also seems to neglect longtermist-relevant topics. Sections 2 through 4 of this report highlighted several places where the existing literature on important questions is very thin. Quantitative forecasts of Great Power conflict and analyses that prioritize policies and programs that could reduce the risks would have been especially useful. Other research gaps identified in this report include:

- Research into long-term trends in warfare and how risks from war are changing over time
- Forecasts of future trends in Great Power relations

²³³ “Carnegie, which was founded as a foreign policy think tank, is currently the only international think tank in China with a foreign policy focus. The only other foreign think tank with a presence in China is the Brookings Institution” “A Conversation with Paul Haenle on April 22, 2014” (GiveWell), accessed August 3, 2021, <https://files.givewell.org/files/conversations/Paul%20Haenle%204-22-14%20%28public%29.pdf>.



- Research into the relationship between international rivalries and technological development
- More analysis of the causes of war and drivers of peace, including international trade, international institutions, and cultural and scientific exchanges
- Research into which foreign policies are likely to reduce international tensions
- Research into the effectiveness of specific programs, including Track II diplomacy and academic, business, or scientific exchanges

Only a small proportion of IR research is directly connected to policy recommendations. An analysis of all papers published in the top 12 IR journals between 1980 and 2007 found that only 12% offered a policy recommendation.²³⁴

Why has this situation come about? Some hypotheses:

- Academics are incentivized to carry out research projects that will generate reliable, novel results. These may not always be the most important or policy-relevant projects
- Few philanthropic funders choose to fund research based only on what they expect to have the biggest impact. Instead, their interests are affected by their history, political orientation, and leadership.
- Think tanks are incentivized to work on topics for which they can get funding and build their reputation.

These factors suggest that an impact-oriented philanthropist could have outsized impact by supporting research that would otherwise be neglected. An example of the kind of research we think could be useful is [a recent report from the National Committee on U.S.-China Relations](#) that surveyed think tanks and other research centers to “assess the state of China-focused international relations and peace and security programs in the United States.”

Policy advocacy

While some topics are under-researched, there is a large body of IR literature on the causes of war we can use to inform policy prescriptions. This suggests we could have impact by supporting programs that increase the probability these policies are adopted

²³⁴ “In no year included in the journal article database did the percentage of articles offering specific advice for policymakers exceed 20% of the sample, and for the entire time period, only 12% of articles offered a policy recommendation” Daniel Maliniak et al., “International Relations in the US Academy,” *International Studies Quarterly* 55, no. 2 (June 2011): 456, <https://doi.org/10.1111/j.1468-2478.2011.00653.x>.



How do we identify these policies? Since the field's beginning, there have been entrenched debates between different schools or paradigms of IR. In some cases, decades of debate have not provided more clarity on which policies are optimal. The effectiveness of deterrence is a good case study. Some (though not all)²³⁵ realist scholars have been more likely to support deterrence measures and military build-ups. By raising the costs of going to war, they argue, deterrence policies make war less likely. In contrast, liberal scholars have focused on the tendency of states to reciprocate the actions of their rivals. If military build-ups are likely to be matched by similar actions from rivals, then they are likely to initiate conflict spirals and make war more likely. Empirical studies have failed to decisively shift the debate one way or the other.²³⁶ Some case studies and analysis show that deterrence works, while others show that it fails. This makes determining the conditions under which deterrence succeeds, and where those conditions currently hold, important, but similarly ambiguous, questions.²³⁷

Fortunately, not all policies are as contentious or difficult to study as deterrence. In some cases, the evidence of a policy's effectiveness is more conclusive, or there is a high degree of consensus among researchers that a policy works.

Evidence of effectiveness

We have discussed the findings of the IR literature on the causes of war in earlier sections. We reported mainly on empirical studies of the effectiveness of different policies rather than the theoretical cases for and against different policies advanced by advocates from different "schools" of international relations. Focusing on the differences of opinion among researchers from different IR schools belies the fact that on many policies there is a high degree of consensus. Indeed, the field as a whole is less cleanly divided across

²³⁵ "It is true that many realists adopt some version of the deterrence model, and argue that coercive strategies help to promote peace and security. Many other realists, however, believe that under some conditions there is a tradeoff between peace and security" Jack S. Levy and William R. Thompson, *Causes of War* (Chichester, West Sussex, U.K. ; Malden, MA: Wiley-Blackwell, 2010), 62.

²³⁶ "Most of [the empirical research on deterrence] has focused on immediate deterrence rather than general deterrence, and more specifically, it has focused on immediate extended deterrence, reflecting one of the central concerns of the U.S. in the Cold War era. The results have been inconclusive and contentious" Greg Cashman, *What Causes War? An Introduction to Theories of International Conflict*, Second Edition (Lanham, Maryland: Rowman & Littlefield, 2014), 348–49.

²³⁷ "What can we conclude about deterrence as a way of preventing war? Here are a few modest comments. First, we know that deterrence is hardly foolproof: sometimes it works; sometimes it fails. The difficulty is determining when and how deterrence fails." Greg Cashman, *What Causes War? An Introduction to Theories of International Conflict*, Second Edition (Lanham, Maryland: Rowman & Littlefield, 2014), 366.



paradigmatic lines than some analyses would suggest.²³⁸ Most IR papers are now post-²³⁹ or non-paradigmatic.²⁴⁰ The arguments they advance are not based strongly on assumptions specific to one of the classic schools. The prevalence of quantitative methods also makes it easier for researchers to directly examine empirical phenomena, which generally requires them to make fewer untested assumptions about causal relationships.

IR researchers are regularly surveyed by the Teaching, Research and International Policy Project. Those surveys regularly show a high degree of consensus among respondents on most policy issues, even controversial ones. For example, in 2021, on five of the seven questions on US-China policy, more than 75% of the roughly 800 respondents were in agreement:

²³⁸ For example, it is somewhat common for introductory IR resources to begin by describing the different schools of thought, or to trace disagreements to fundamental assumptions underlying the different schools.

²³⁹ Patrick Thaddeus Jackson and Daniel H. Nexon, "International Theory in a Post-Paradigmatic Era: From Substantive Wagers to Scientific Ontologies," *European Journal of International Relations* 19, no. 3 (September 2013): 543–65, <https://doi.org/10.1177/1354066113495482>.

²⁴⁰ "Most peer-reviewed research in the major journals is what we call "non-paradigmatic," and the proportion of work classified as non-paradigmatic has risen over the past two decades. By non-paradigmatic research, we mean hypotheses or theoretical frameworks that are not deduced from the core assumptions of one or more of the four paradigms" Daniel Maliniak et al., "International Relations in the US Academy," *International Studies Quarterly* 55, no. 2 (June 2011): 446, <https://doi.org/10.1111/j.1468-2478.2011.00653.x>.

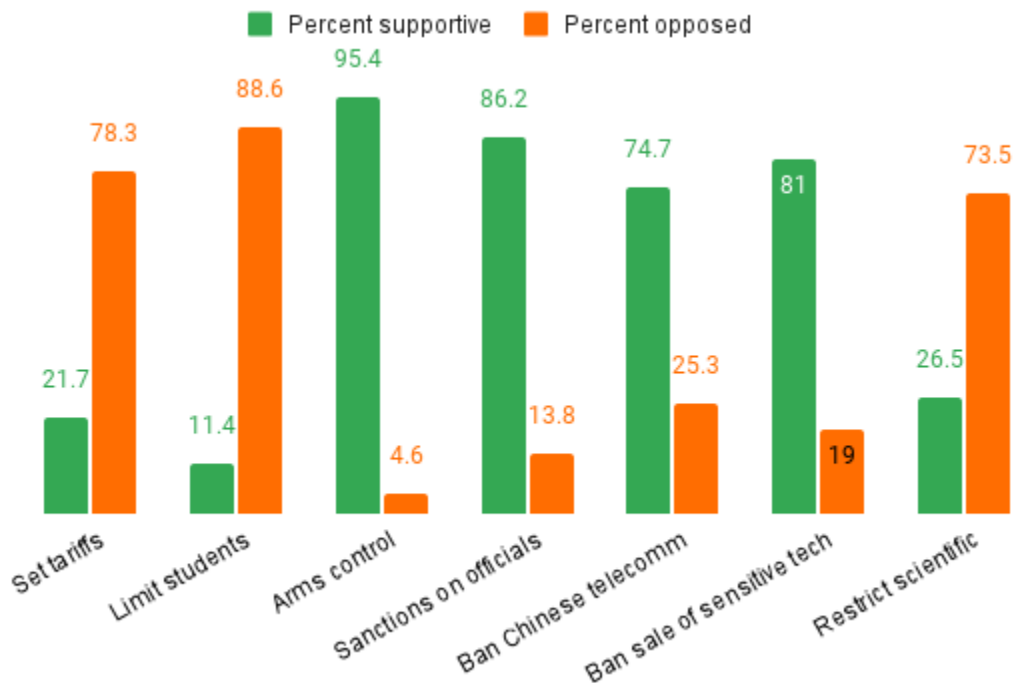


Figure 26: Expert consensus on US-China policy

Source: Susan Peterson, Ryan Powers, and Michael J Tierney, "TRIP Snap Poll 15 Report," Teaching, Research & International Policy (TRIP) Project (Global Research Institute, May 2021).

In general, researchers appear to support efforts to de-escalate arms races and negotiate arms control treaties and to limit technological exchange in areas related to defense and security. However, they are opposed to efforts to restrict academic and scientific exchanges.

Track 1.5 and Track II diplomacy

Track II diplomacy initiatives are diplomatic efforts by non-governmental actors that take place outside of official government-to-government channels. These can include a variety of activities, including dialogues, workshops, and presentations, and can involve participants like scientists, retired military or government officials, community members, and NGO workers. Some initiatives involve both official and non-official actors as participants and facilitators. Such programs are known as Track 1.5 diplomacy.

Advocates of Track II programs, who often work in academia or non-governmental organisations like think tanks, claim they complement official, or Track I, diplomatic efforts.



In recent years, American foundations spent between \$1 million and \$4 million per year on Track II diplomacy programs.²⁴¹ While not an insignificant amount of money, this level of spending is very small compared to state diplomacy budgets or philanthropic spending on defense policy research and advocacy. This makes Track II diplomacy a promising intervention candidate for philanthropists looking to have an impact at the current margin, if it is effective.

The Pugwash Conferences are perhaps the most well-known example of Track II diplomacy. Starting in 1957, the Pugwash Conferences brought together scientists from multiple countries, including both the United States and its allies and the Soviet Union and its allies, to share information and discuss security issues. Some researchers claim that Pugwash participants helped shape international treaties such as the Non-Proliferation Treaty and the Biological Weapons Convention and provided a communication channel between the US and the Soviet Union during times of heightened international tension. It is also claimed that Pugwash participants directly moderated Soviet defense policies through their interactions with Soviet leadership.²⁴²

Theory of effectiveness

Track II diplomacy efforts could have a positive impact in several ways. First, they could work by increasing the flow of information between countries. Military strategies account for both the estimated military strength and perceived intentions of rivals. Successfully negotiating agreements to reduce tensions requires both sides to believe that the other will uphold the agreement, as well as transparency to allow enforcement and monitoring. For these reasons, researchers interested in finding ways to avoid security dilemmas and other arms race dynamics have focused on efforts to increase transparency and reassurance between negotiating parties. Such efforts include sharing information, increasing transparency about capabilities and decision-making, establishing processes to explain policies, and increasing trust through cooperation in other areas.²⁴³

²⁴¹ “During the 2002–2011 period, for example, U.S. non-governmental foundations together spent from \$1 million to \$4 million per year on Track II programs” Nathaniel Allen and Travis Sharp, “Process Peace: A New Evaluation Framework for Track II Diplomacy,” *International Negotiation* 22, no. 1 (February 20, 2017): 93, <https://doi.org/10.1163/15718069-12341349>.

²⁴² “[Matthew Evangelista] claims that in fact transnational activists were quite influential in shaping Soviet foreign policy, particularly on nuclear testing, antiballistic missile (ABM) systems, and the reduction of conventional forces, albeit to varying degrees over time. Their information and ideas, shared directly and indirectly with Soviet leaders, led to the moderation of hardline policies” Valerie Sperling, “Unarmed Forces: The Transnational Movement to End the Cold War.,” *Journal of Cold War Studies* 3, no. 3 (September 1, 2001): 101, <https://doi.org/10.1162/jcws.2001.3.3.100>.

²⁴³ “[W]hat kinds of variables ameliorate the impact of anarchy and the security dilemma? [...] You can improve the gains that result from mutual cooperation. You can increase the cost of defecting. You can also improve the reliability and robustness of information flow to make sure that both sides are more



Particularly when it comes to the development and deployment of new technologies, decision-makers may be more likely to take risks and make poor decisions when their understanding of their opponents' capabilities is poor.²⁴⁴ If decision-makers are likely to systematically overestimate their opponents' capabilities, assume bad intentions, or take more risks when they have less information, then increasing the amount of information flowing between rival states is likely to be positive. If these conditions do not hold, though, then it is plausible that information flow also has downside risks. For example, Track II programs could give states which are committed to deterrence more opportunities to demonstrate their military capacity, make threats, or spread misinformation.

Another reason to think Track II programs have more upside than downside, though, is that they give states another opportunity to resolve misunderstandings and false alarms before they escalate. Great Power tensions could escalate to existential risk either deliberately or accidentally. Even if Track II diplomacy does not affect probability of deliberate escalation, it seems much more likely to decrease the chance of accidental escalation than to increase it. In this case, the total expected impact of Track II diplomacy would be positive, though its magnitude would still be highly uncertain.

Finally, it is plausible that Track II diplomacy initiatives provide more opportunities for rival states to build trust and demonstrate their commitment to negotiated settlements. Recall that security dilemmas can be exacerbated if one side does not believe that the other side will uphold the commitments it makes in negotiated agreements. Repeated Track II negotiations would allow states to build a track record of cooperation and consistency. However, since it seems just as plausible that such negotiations could provide more opportunities for states to break their commitments, this does not seem like a strong consideration.

Empirical evidence

It is difficult to evaluate the effectiveness of Track II diplomacy. One cannot conduct experiments to compare what happens when such programs are and are not implemented. Nor can one simply compare real-world cases of conflict where Track II diplomacy efforts were and were not implemented, because of endogeneity concerns. Track II diplomacy may be more likely to be funded in situations where conflict resolution is easier, for example. As

reasonably assured that the other will cooperate" Robert Jervis, "Cooperation under the Security Dilemma," *World Politics* 30, no. 2 (January 1978): 170–71, <https://doi.org/10.2307/2009958>.

²⁴⁴ "[F]ear of military opponents intensifies willingness to take risks: If they might be doing X, we must do X to keep them from getting there first, or at least so that we understand and can defend against what they might do" Danzig, "Technology Roulette: Managing Loss of Control as Many Militaries Pursue Technological Superiority," 8.



a result, the academic literature includes several case studies of successful Track II diplomacy efforts, but few systemic, quantitative evaluations of their average effectiveness. There is a lack of consensus among researchers regarding how effective different strategies are and under what conditions.²⁴⁵

Still, there is at least some evidence that Track II diplomacy is effective. One statistical analysis regressed conflict outcomes on the presence or absence of Track I and Track II diplomatic mediation. The results indicated that the chances of reaching an “effective outcome” were about 60% higher when Track II diplomacy efforts were present, and about 90% higher when both Track I and Track II diplomatic efforts were made.²⁴⁶ This study is far from definitive. First, it is difficult to rule out the possibility that unobserved covariates drive the relationship between diplomatic efforts and conflict resolution. Second, the author measures the outcomes of diplomatic efforts on a scale from 0 to 5, where 0 is no effect and 5 is “full settlement”, which invites a degree of researcher freedom that may reduce the robustness of the results. Finally, results from single studies that have not been replicated or supported by other work should generally be treated with caution. For these reasons, the results of this study seem more suggestive of the likely sign of Track II diplomacy efforts than conclusive regarding its magnitude.

Recommended interventions

Based on the evidence covered in previous sections of this report, we are currently recommending two of the above interventions as particularly likely to be good bets for philanthropists.

First, we recommend **research into diplomacy and defense policies that seem most likely to maintain peace and avoid conflict escalation**. This is based on the relative lack of good evidence on effective interventions and especially on research into Great Power conflict that takes a long-term view.

Second, we recommend **Track II and Track 1.5 diplomacy programs**. This intervention stands out because it has (i) a strong theoretical case for effectiveness, (ii) some supportive empirical evidence and support from experts, (iii) seemingly high upside and minimal downside risk.

²⁴⁵ “[I]n their comprehensive review of the field, Wallensteen & Svensson (2014: 315, 319) conclude that “the particular conditions under which mediation is effective are still debated [...] There is [...] no consensus among researchers and practitioners as to which strategy is used the most and which is most effective.”” Allen and Sharp, “Process Peace,” 94.

²⁴⁶ See Table II in Tobias Böhmelt, “The Effectiveness of Tracks of Diplomacy Strategies in Third-Party Interventions,” *Journal of Peace Research* 47, no. 2 (March 1, 2010): 174, <https://doi.org/10.1177/0022343309356488>.



Uncertainties, limitations, and directions for future research

Considering the breadth of the issues it addresses, this report is necessarily limited in several ways. First, its scope is relatively narrow. Several important, related issues are not included. This is not a judgement on the relative importance of these issues. For instance, we think research into risks like the use of weapons of mass destruction by rogue state or non-state actors²⁴⁷ would be valuable.

Second, the review of the literature on the causes of war in section 2 is far from comprehensive. Further research to identify the most important findings from this literature with respect to long-term Great Power conflict could prove highly valuable.

Third, the forecasts of future conflict risk that conclude section 3 are closer to a first step than the final word on this important question. We expect that more sophisticated statistical modelling and/or better data would give different, and improved, estimates. Other valuable work could include estimating the likelihood of different geopolitical pathways and making conflict risk estimates for each scenario; disaggregating conflict risk estimates by type of conflict (for example, estimating the probability of nuclear weapon use given Great Power war); and giving more robust upper and lower bounds for conflict risk given different assumptions. Such work seems highly valuable for better estimating the effectiveness of different interventions and comparing them to other interventions that seek to mitigate global catastrophic risks.

Fourth, section 4's model of how different risks flow from Great Power tension is highly simplified. More advanced modelling might consider feedback loops and interconnections between the different nodes in the model. We think the model used for this report is a useful clarification of how, exactly, Great Power tension acts as a risk factor that ultimately increases total global catastrophic risks. But the specific percentages and correlations we use to model this risk are likely fragile, and further calibration work would improve the model.

Fifth, we found the literature on the effectiveness of different interventions in this space to be relatively thin. Primary research into the effect of different policies for maintaining Great Power peace, as well as research into effective strategies for promoting and implementing

²⁴⁷ "While interstate conventional wars are likely to remain rare for the foreseeable future, there will still be states and nonstate groups willing to use force to further their political objectives. These actors are likely to continue to employ the techniques of irregular warfare to offset the military advantages of the major powers" Wither, "Warfare, Trends In," 2431.



these policies, should prove useful. We have recommended funding such research as one of the most promising interventions in this space, and will update our recommendations if and when more research is available.



Conclusion

We briefly conclude the report by emphasizing ten of its most important findings:

1. Competition between Great Powers is likely to occur during the coming century. This competition can take place across a range of domains, from trade policies to investments in technology to military disputes.
2. Multiple future pathways remain possible, ranging from peaceful cooperation to all-out conflict. Because transformative technologies could be invented this century, humanity's choice of which pathway to follow could have very long-term effects.
3. Wars have many different causes. Because these are intrinsically difficult to study, it is difficult to make strong claims about which are most important or concerning with respect to predicting future conflict risk. But the large body of literature that has been produced on this question over the last 100 years has produced some important findings and stylized facts. In particular, it draws our attention to ideological differences, territorial disputes, and escalating rivalries as particularly concerning factors.
4. Our current best estimate of the chance of a Great Power war in the next 100 years is about one in three.
5. This estimate is lower than the historical incidence of two such wars per century. Our estimate is lower than the historical trend because we put significant credence on an "optimistic" view that lasting trends such as globalization, the advancement of liberal norms, and taboos on major war and the use of weapons like nuclear warheads have made peace more profitable and war more costly.
6. However, one in three is above the trend of the last 75 years, which have seen zero Great Power wars. Our estimate for the 21st century is higher than this because we also have some credence in a view that long gaps between Great Power wars are in line with a power law distribution of conflict severity. The U.S.-China and China-India relationships also have some worrying characteristics, including ideological differences, territorial disputes, and histories of antagonism and rivalry.
7. After modelling the potential pathways from Great Power tension to global catastrophe, we suspect that the bulk of the existential risk is driven by the potential for tension and war to drive the development and deployment, either by



accident or on purpose, of very powerful weapons. Humanity's war-making capacity exploded in the 20th century and could continue to rise with the invention of new weapons technologies, including weapons of mass destruction.

8. There are a variety of interventions philanthropists could fund, including field-building efforts, research projects, policy advocacy, and Track 1.5 and Track II diplomacy programs
9. Research on emerging technology issues and non-official diplomacy programs are particularly neglected by existing funders
10. We recommend impact-focused philanthropists support practical research into effective policies for long-term peace and Track II diplomacy programs. Our current recommended funding opportunities can be found on Founders Pledge's research page.