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Examining Long-Term Climate-Related Security Risks through the Use of Gaming and Scenario Planning

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Abstract: This paper examines four possible climate change-related security risks that emerged from an international game and scenario-planning session held in Delhi, India. Specifically, we discuss how climate change may increase nationalism and policies of internalization in developed countries; the impact of large-scale, climate-induced migration on a country's international policies, economic situation, and defining cultural attributes; the competition for limited resources as a source of friction and the impact on policies and international relations; and the potential for an emerging disparity between regions over the consensus and control of climate change-related technologies.

Keywords: gaming, scenario planning, climate change, security risks, nationalism, internalization, migration, resources, politics, economy, technology, culture, international relations, European Union, geoengineering

The consequences of climate change are uncertain, but they have the potential to adversely affect human interests. For years, leading scientists have claimed that climate change is a problem of risk management.

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To manage these risks, we must assess them not only from an environmental standpoint but also from social, political, and security standpoints. Over the past year and a half, the United Kingdom's Foreign & Commonwealth Office (FCO) held multiple meetings and compiled a 2015 report, *Climate Change: A Risk Assessment*, to better understand the risks associated with climate change. In the assessment, the FCO touches on the environmental, social, political, and security risks associated with climate change.[1] In support of the assessment research, FCO, partnered with the Skoll Global Threats Fund (SGTF), asked CNA to provide analytical support for an assessment of risks precipitated by climate change. To do this, we designed and executed a game and scenario-planning session that explored the effects of climate change on global security and economic prosperity. Our conclusions speak both to the interplay between climate change, security, the economy, and international and domestic politics as well as the use of interactive tools and methods to maximize innovative and imaginative thinking.

In this article specifically, we briefly discuss the benefits of using gaming and scenario planning for our approach, and we describe how we refined the climate risk event during a test run.[2] After summarizing each of the four games, we conclude this report with a discussion of our four major findings in the order of most to least prominent:

1. Climate change may trigger increased nationalism and policies of internalization in developed countries.
2. Large-scale, climate-induced migration and displacement may impact a country's international policies, economic situation, and defining cultural attributes.
3. Competition for limited resources may increase as a source of friction and shape policies and international relations.
4. The consensus and control of climate-related technologies may result in an emerging disparity between regions, as not all countries view these technologies in the same way, and there is little framework for their use or management.

Moreover, we made two interesting observations of participant behavior during the event. One of the more interesting observations from the game was a tipping point that emerged midcentury, when climate change began to make country players selfish, more insular, and more willing to take risks to preserve the status quo for their nations. From the scenario-planning session, participants discussed two potential shifts in governance: the potential disaggregation of the European Union and the possible emerging role of private corporations in climate-related decision making.

Event Objectives

Before designing the event, we laid out several objectives. Analytically, we wanted to understand the security implications and risks of climate change and rising temperature during the next 100 years. We did not want to focus on a specific region; rather, we wanted to explore how people and governments might react to extreme climate change and during a long period of time with significantly rising temperatures.

It was important to maximize imaginative thinking and to gain a variety of insights from the high-ranking officials who participated in the event. To reach these objectives, we used two techniques: gaming and scenario planning. On the first day, we ran the same game simultaneously with four separate player groups. For simplicity throughout this paper, we refer to each of these as Game 1, Game 2, Game 3, and Game 4 even though the rules, game boards, player roles, and other components were the same. On the second day, we held four separate scenario-planning discussion groups. By running the same game more than once, we were able to observe how different decisions by players could lead to different outcomes, reactions, and interactions. Because the players in each set could use their collective imagination, we were not restricted to the imagination of a single group. The same participants were reorganized into scenario-planning discussion groups where they raised issues that they had considered the biggest risks. Group members then debated these topics. In this environment, individuals from different backgrounds interacted and built on the issues identified by others in the group, which resulted in a rich dialogue during the two-day event.

By incorporating gaming and scenario planning into the event, we were able to offer a more flexible format for engagement and interaction between participants compared to other climate change meetings. This event allowed us to use unique tools that engaged high-level participants with a multitude of backgrounds and areas of expertise. The game placed participants in a decision-making role that encouraged them to use their imagination, while the scenario-planning session created an environment that allowed participants to expand upon topics, decisions, and outcomes that emerged from the game. The scenario-planning session also allowed cross-cultural and multidisciplinary discussions that might not have occurred in other climate or security conversations.

The Council on Energy, Environment and Water (CEEW) hosted the event on 19–20 March 2015 in Delhi, India. Twenty-four participants attended and included renowned scientists, security experts, diplomats, and retired military personnel representing perspectives from Asia, Europe, the United Kingdom, and the United States.[3]

Using Gaming and Scenario Planning for Decision Making

Understanding what the next century may look like is especially challenging because of the volatility of human behavior and decision making: both of these elements can be unpredictable. Games and scenario-planning tools, however, are designed to help better understand human behavior and decision making. These tools can help to (1) reveal the processes behind decision making, (2) understand what types of decisions could be made, and (3) understand the impact of those decisions and how different decisions could lead to different impacts. By using both tools, we can generate what the future could look like, or even what different futures could arise, even if we cannot precisely predict the future. In this event, we combined games with scenario planning to increase the depth of participants' experiences. In the scenario-planning exercise, individuals drew on what they learned in the games to influence and extend their consideration of other scenarios and other futures.

By having players participate in a complex game where they interact with each other and possible future outcomes, they begin to understand some of the key drivers, relationships, and decisions that might be encountered in the future. If senior, high-level individuals with government experience are playing the game, they bring an increased realism to those decisions and relationships. Games place the participants in the future, where they learn how they would adapt and act to new situations. Scenario planning can further extend gaming's reach by allowing participants to examine multiple possible futures simultaneously.

Neither gaming nor scenario planning can predict the future, but gaming can immerse players in a mutually constructed future that is based on analysis and research. The evolution of players' reactions and actions during the course of the game is, in fact, a simulacrum of how leaders might react in a given future. Scenario planning allows players to incorporate these feelings and reactions into considerations of a variety of expanded scenarios. Players accept or reject those scenario elements based on their experiences in the game.

How Does This Affect the Way We Think about Climate Risks?

The combination of games and scenario planning allowed for an expansive experience for the players. Players had to think deeply about how they would react to the effects of climate change in terms of one possible future, and then apply that thinking to many possible different futures, including the long future. Understanding the long future is valuable for both understanding larger climatological, economic, and social processes, as well as how leaders might react and adapt to each other over longer periods of time. Games give players a chance to experience all of these variations, which can change the way they

think about the future. One thing that games are capable of doing is identifying those ideas and actions that players may not have considered as possibilities before the game. In our games, players identified several unintended consequences and possible social behaviors that were unexpected prior to the start of the game. Players then had the chance to discuss and reinforce those consequences during the scenario-planning phase.

Can Games Predict the Future?

This is an interesting and controversial question. At some level, computer simulations often claim that they can predict a future from a set of inputs. Physical systems—for example, a molecular dynamics model—can be used to run time forward or backward for a set of physical conditions and parameters. But, computer models fail in large-scale, long-time predictions because they often fail to incorporate the element of human free will in their calculations. People can be perverse, and as modern economics shows, not necessarily behave like rational actors when making decisions.

Games allow us to incorporate these irrational, human elements into an assessment of the future, allowing us to understand what patterns may develop and how our decisions might be affected by and affect these future patterns. Future decision makers can reference these game experiences when they see familiar patterns occurring and either steer clear of potentially bad outcomes or move toward good ones based on what they learned in the games. This matters for climate risk because, while we can run models and simulations to understand future climate events given various emissions scenarios, understanding how people may react to the consequences of various actions, or inaction, is much more challenging.

Our games showed several important reactions that are likely to carry into the future; for example, we saw the following player behaviors emerge. First, there was a tendency not to engage in large-scale, global conflict between peer competitors.[4] Instead, small-scale skirmishes and fights over less developed regions occurred in the game. Second, technologists advocated the use of geoengineering as climate effects became more pronounced.[5] And third, we witnessed global fatigue with failed states and migrants emerging in the game.[6] The players saw this as driving increased xenophobia and closure of borders. We could argue that we are already seeing harbingers of the events that emerged during our games. These elements will not necessarily emerge in simulations or computer models, but clearly depend on the feelings and actions of real people making decisions. That is what games can tell us about the future: not what it will be like, but how individuals might react to it.

Game Design

The first day of the two-day event was dedicated to the game, and was designed as a strategic role-playing game that looked at the interactions between the climate, the economy, and conflict from 2015 to 2115. In strategic games, player decisions strongly influence the direction and outcome of each game. In this game, actions taken by players determined the emissions pathway for the game. In role-playing games, each player is assigned a role that determines the kinds of decisions that the players can make in the game.[7]

One of the key design requirements was that players could alter their emissions pathway to affect global environmental conditions. We wanted to avoid a predefined trajectory that was isolated from the players' decisions; therefore, the game design factored the players' behavior and investment decisions into each turn's climatological conditions.[8]

To provide sufficient flexibility for the players, we allowed them to take actions that were not in the formal rules of the game. In those cases, players worked with the game controller to determine how the action fit into game play.[9] Each of the four games was composed of six players who represented China, the European Union, India, Russia, the United States, and the region of Southwest Asia. These areas were selected because of their projected demographics, wealth, military strength, and climate impacts. Players were grouped based on their background and subject matter expertise.

To cover 100 years in one day of game play, each turn represented 10 years, meaning that events resulting from player actions, climate change, temperature increases, and sea-level rise had to be significant enough to register on the world or national decadal economic, military, or population scales. Costs had to be in the hundreds of billions and lives lost in the hundreds of thousands to millions to cause a significant change. Some events, while devastating, do not meet these thresholds; for example, the effects of a super typhoon, such as Typhoon Haiyan (2013), would barely affect the decade's gross domestic product (GDP) or population.[10] The 2004 Indonesian tsunami and the 1986 Chernobyl disaster are examples of events that would register at this scale.[11]

When a player made a decision, the outcome of that decision was based on several underlying models and mechanics for the economy, climate, and conflict.[12] The abstracted models were based on projected GDP values, regional population predictions, global climatological relationships, and other factors. For projected GDP values, we used and extrapolated data from the Central Intelligence Agency's *World Factbook* and the World Bank. Regional population predictions were based on the United Nations' population projections.[13] Global climate relationships and other factors were mainly based on the Intergovernmental Panel on Climate Change's (IPCC's) fourth and fifth assessment reports and related research documents.[14]

In the game, we held technological developments constant between players, player groups, and across time, except in a few cases. We permitted players to make advancements in military equipment and climate technologies, but we did not allow for other advancements, such as flying cars or artificial intelligence. Because we were mainly concerned with the interactions between security, climate, player behavior, and decision making, we assumed large technological advancements in other areas were incorporated into economic growth and would be a major distractor and disrupt game play.

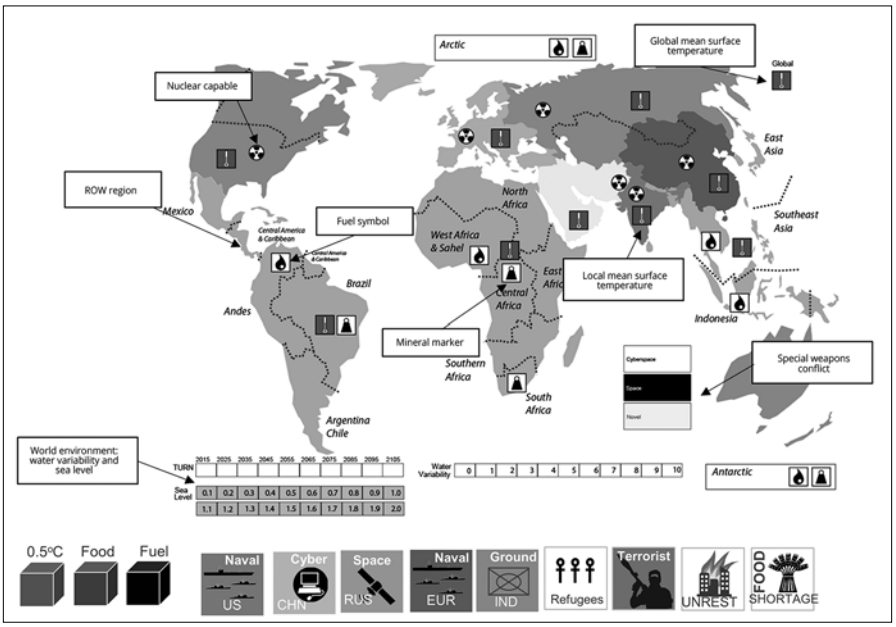
The players were asked to (1) ensure that their countries had enough food and energy to sustain their needs, (2) support their militaries, (3) protect their homelands, (4) decide whether they wanted to invest in climate mitigation and adaptation efforts, and (5) decide which investments were most important to their countries. Possible investments included, but were not limited to, increasing food production, incorporating water stress adaptations, improving civil infrastructure, researching and implementing geoengineering, building military capabilities, and exploiting the Arctic for natural resources. Consequently, player decisions changed the global temperature, sea level, and water variability.[15] In turn, players reacted to the events that were triggered by these changes. Because we ran four simultaneous games, we were able to see how players' decisions resulted in different futures.

In each game, the current state of the world was displayed on a game board (figure 1). The board contained information about global and regional temperatures, represented by red cubes, and regions' food and energy supplies, represented by purple and black cubes, respectively. Counters represented regions' military assets; the locations of migrants, civil unrest, terrorist forces, and insurgents; as well as shortages. In reference to unrest, when countries and regions were unable to meet their food, energy, water, or financial needs there was unrest, which could generate an increase in migrants, terrorists, or insurgents. Migrants could move from region to region and create additional unrest, terrorists could also move and conduct attacks, and insurgents could try to take over areas. Players had to make trade-offs between future investments and dealing with these issues.

Scenario Planning

The second day of the event featured the scenario-planning session. The same individuals who played in the game participated in the scenario-planning session. The participants were, however, placed into new groups to further diversify the discussions. During the main event in Delhi, the scenario-planning session was composed of two scenarios: one for the period between 2015 and 2045 and the other for the period between 2045 and 2075. Each scenario included the following:

Figure 1. Game board and counters



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- global temperature ranges, extreme world-wide climate events, sea-level rise, and global food availability
- the regional effects of these factors on China, Europe, India, Russia, and the United States
- a summary of the major climatological conditions in other key parts of the world

The primary goal of the session was for participants to explore low-probability, high-impact risks; therefore, we presented them with global temperatures at the upper end of current predictions and extreme climatological conditions.[16] Based on these environments, we asked participants to consider the types of events that might be unlikely but would have a severe impact on human security. This forced participants to consider the biggest risks, not just the most likely ones, and thus to think outside their normal comfort levels.

For these sessions, the participants—a mix of scientists, diplomats, security experts, and retired military personnel—were organized into four discussion groups of six. Each group had a moderator. By creating an environment for multidisciplinary discussion between different types of experts, the participants learned about climate change risks outside their areas of expertise. At the end of the session, each group compiled a list of the risks that they felt were the

most significant to human security. The moderators presented each group's findings to the rest of the participants. Afterward, the floor was opened up to everyone to submit their final thoughts on both the event and any outlying issues.

Washington, DC, Test Run

As mentioned earlier, we tested the game and scenario-planning sessions before the main event to refine the game materials, player roles, and climate scenarios.[17] Because of the test run, we were able to refine the game for faster and more fluid game play, thus increasing the turns played. Originally, the game materials included pages of investment options and required players to execute many numerical calculations during every turn. These detailed materials and calculations overwhelmed the players and slowed game play. To raise the game to a strategic-level, decision-making game and limit managing minute details, we incorporated these calculations into the game model and mechanics and provided players with fewer investment options.[18]

The test run game was comprised of seven players: China, the European Union, India, Russia, the United States, a "rest of world" player, and a "stateless" player. The rest of world player managed 15 different regions, most of which required minimal attention. The Southwest Asia region, however, required more management than the other regions; therefore, we eliminated the rest of world player and created a Southwest Asia player for the main event in India. Collectively, all of the players supervised the stability of the remaining regions during the main event.

In the test run, the stateless player held two roles simultaneously: global business player and terrorist player. As the global business player, this individual represented global capital and services. He or she could purchase food and fuel from the other players, warehouse it for later use, and provide food, fuel, and financial loans to players in need. This mechanic, however, further complicated the numeric calculations being made by the players without adding a great deal of insight. As a result, we decided to eliminate the global business player role. The terrorist player represented anarchy and disruption around the world. As unrest developed in countries, this individual could move terrorist forces and conduct attacks. We determined, however, that the level of global unrest around the world did not require a dedicated player, so the game controller assumed the terrorist player responsibilities.

Lastly, we adjusted the climate scenarios for the scenario-planning session. In the test run, we presented players with three different climatological scenarios. The first two scenarios were similar to the ones described above, but the third scenario included temperature increases of 6–7 degrees Celsius from today's temperatures to the period from 2075 to 2105. We found the third sce-

nario exceeded the participants' imaginative abilities. In addition, there is little scientific data on the state of the world at these temperatures to provide useful conclusions. Overall, the test run proved useful in developing and refining our game and scenario-planning sessions. It helped us to eliminate the unnecessary portions of the event, better concentrate on the interactions between key players, and as a result, better understand the impact of climate on human security.

Game Play

In this section, we briefly summarize each of the four games that were held in India. Specifically, we identify some of the main themes that emerged and how the players interacted with each other. Players for each game were divided based on their backgrounds and expertise. Individuals in Game 1 had strong scientific backgrounds, while Games 2 and 4 were composed of individuals with various military backgrounds. Players with diplomatic experience were assigned to Game 3. Recall that, by design, player decisions drove the progression and direction of the game. As each group of players made decisions, every game went in its own direction and highlighted distinct insights despite the fact that each set of players had the same set of options to choose from when making their decisions. Full analysis on these insights is provided in the later sections.

Game 1: Mutually Beneficial Mitigation

Game 1 play was characterized by the desire to eliminate unrest among the players, with the goal of reducing carbon emissions by heavily investing in energy alternatives, and by deciding to implement geoengineering techniques. At the start of the game, there was a mutual understanding among the players that any food shortages, clean water shortages, and unrest must be mitigated immediately. This agreement applied to each player's domestic situation as well as the rest of the world. In this vein, players representing China, the European Union, Southwest Asia, and the United States devoted resources to regions in need, including the Andes, Indonesia, Mexico, and parts of Africa.[19] The players felt especially responsible for regions in their spheres of influence that posed a threat to domestic stability; for example, the player for the United States frequently stopped unrest and provided food to the Andes region because of its geographic proximity and availability of natural resources to satiate the United States' energy needs.

The players representing China, the European Union, and the United States led the climate negotiations in Game 1. Each player agreed to invest in energy alternatives with a target of reducing emissions by 30 percent in each of their respective countries through alternative energy by the midpoint of the game. Those countries easily achieved this goal. The Southwest Asia and India players attempted to meet this target, but unexpected events overtook their ef-

forts. Because the India and Southwest Asia players demonstrated a good faith effort, the China and the United States players provided funding to help them meet their respective targets. The Russia player purposefully spurned all climate mitigation and adaptation efforts and instead built up the country's military. During the midpoint of the game, the Russia player allowed domestic food shortages and unrest to emerge because the player wanted to spend additional money on offensive military assets in an attempt to instigate conflict with the China player over border disputes. Since this conflict did not escalate to war, the Russia player was left with a large number of internal issues to resolve. Despite the Russia player's attempted aggression toward the China player and lack of compliance with the international emissions reduction agreement, the United States player and others assisted the Russia player with their food shortages and unrest. Throughout the game, the players consistently approached unrest with a compassionate attitude and willingness to help others.

During Game 1, players honed in on the consequences of using new technologies. Implementing geoengineering, specifically stratospheric aerosols, significantly changed the global emissions path, thus changing the frequency and severity of climatological events. This reduction in climatological events allowed players to concentrate on other issues. Early in the game, the United States player proposed geoengineering to further reduce emissions with the support of the China, European Union, and India players. In contrast, the Russia and Southwest Asia players strongly opposed these efforts. Specifically, they protested the unknown risks and the potentially negative consequences.[20] While these objections were considered by the other players, the United States player went forward with implementation, as the Russia and Southwest Asia players lacked the necessary resources and relative power to stop the United States player. This disagreement spurred a discussion about the implementation of new and unknown technologies (i.e., who has the right and ability to implement them as well as who can deny implementation).

Game 2: Eventual Forced Cooperation

Relative to the Game 1 players, the Game 2 players were generally not coordinated or cooperative in eliminating unrest and mitigating climate change. The players largely focused on their domestic natural resources, military, and economic growth. The China, India, Russia, and Southwest Asia players saw themselves as developing countries that needed to organize their domestic affairs before they could make foreign aid investments; for example, the India player felt they had to achieve near-peer military parity with the China and Southwest Asia players before they would invest internationally. Similarly, the China and Russia players built up their militaries and domestic resources. The China player acquired an amphibious task force and invested in food production for China's

growing population. The Russia player reinforced their domestic infrastructure. Lastly, the Southwest Asia player developed a robust desalination capability to generate water and greater food production capabilities to offset future food insecurity.

There were some exceptions to this behavior. The European Union, India, and United States players mitigated unrest outside their borders; for example, the European Union player deployed their military to North Africa to alleviate unrest and contributed foreign aid to other countries to develop their renewable technologies, primarily in nuclear energy. The United States and India players also invested internationally, but it was limited to their spheres of influence and still supported domestic goals; for example, the United States player quelled instability in Mexico, partly to prevent the unrest from spilling over the border. This effort was prioritized over instability in North Africa. The India player limited India's international efforts to fighting terrorism and unrest in Bangladesh and Pakistan. Given this lack of international cooperation, global instability and climate effects eventually overwhelmed individual players and forced all the players to cooperate.

This cooperation only occurred when climate change events reached a tipping point that had simultaneous impacts on multiple regions. Early in the game, only a few players decided to invest in climate mitigation and adaptation efforts. The India player invested in nuclear energy, but without consistent climate mitigation efforts from all the players, these reductions were insufficient to offset global emissions. Consequently, global temperature continued to rise in the game, forcing later cooperation. To combat the rising global temperature, the European Union player proposed geoengineering to prevent worsening conditions and offered to sponsor the effort. This proposal and the level of global instability were sufficient for the other players to agree to geoengineering. Moreover, injecting aerosols into the stratosphere required continuous investment and monitoring to avoid backsliding into dangerous global temperatures. To avoid this outcome, all the players began to contribute financial resources. Unlike the players in Game 1, Game 2 players only pursued global climate change mitigation when they faced an existential threat.

Game 3: Aggressive Self-Interest

Takeaways in Game 3 were comparable to those in Game 2, but differed drastically from Game 1. Similar to Game 2, the players in Game 3 prioritized their national security efforts, GDP growth, and resource security above global cooperation. The global cooperation that did occur centered on global shortages and climate change. At the start of the game, the United States player suggested that each player contribute a portion of their financial resources (based on economic wealth) to combat global food, fuel, and financial shortages. There were

disagreements, however, about financial contributions and domestic issues. The China player wanted larger contributions from the United States player, which was echoed by multiple players throughout the game. In addition, the other players rebuffed the Southwest Asia player's request for help when their country suffered from food shortages. The other players viewed the shortages as a domestic issue that did not warrant global assistance even though the Southwest Asia player participated in the United States player's proposal to combat global shortages.

Despite these efforts, unrest and shortages spread throughout the world. Some players placed trade restrictions on food and fuel exports in order to fulfill domestic consumption, forcing the European Union and the United States players to either pay off the shortage or allow unrest to emerge. Eventually, the China player retracted their commitment to prevent global shortages because they did not believe the investments were benefiting their country's economy. Since the Southwest Asia player did not receive assistance with food shortages, the player declared that they intended to invade North Africa for natural resources. This threat caused the other players to verbally agree to mitigate future unrest and food scarcity issues, but ultimately, most players ignored unrest until it posed a proximate threat to their country's borders.

The players also disagreed about global climate mitigation efforts. The United States player proposed that each player set emissions reduction targets based on their GDPs, a proposal which was rejected by the other players, especially the India, Russia, and China players. Instead, each player determined his or her own emission targets. Although the European Union and United States players invested in emission reductions, their reductions were not enough to slow the rise of the global temperature.

Throughout the game, the Russia player was internally focused on the military instead of on the larger global concerns broached by other participants. Similarly, the China player invested in domestically beneficial areas, such as GDP and military growth. These investments eventually triggered an arms race that caused other players, such as the United States, to reallocate funds toward their military programs and homeland security rather than climate mitigation and adaptation efforts. The players invested in additional task forces and cyber-capabilities and deployed forces in anticipation of potential conflicts with rival countries. While the European Union player periodically tried to steer the other players toward global stability, the effort was ultimately unsuccessful because of the arms race. Food shortages, migrants, terrorists, and insurgencies began to quickly grow and spread. This consistently uncooperative attitude defined Game 3, setting it apart from Games 1 and 2. Aggressive self-interest, in the end, lead to greater, more intractable problems.

Game 4: Domino Effect of Military Actions

Game 4 largely mirrored Game 3; many players focused on domestic issues and ignored global unrest and climate mitigation efforts. Similar to all the other games, the Russia player focused on domestic improvements and generally spurned international cooperation efforts, including climate change mitigation, except when the effort reaped positive benefits for Russia. For example, the Russia player convinced the European Union player to finance Russia's Arctic exploration efforts in exchange for a future fuel-trade agreement.

In Game 4, as the players representing larger countries focused on aggressive geopolitical maneuvering with little concern for stewardship and leadership, players from the smaller countries could not make an impact on climate change. Similar to the Russia player, the China player also focused on domestic infrastructure improvements, particularly food production. Anticipating future food shortages, they hoarded food early in the game and continued focusing on nationalism by building and maintaining military and defense capabilities. In later years, the China player devoted some resources to stem unrest in areas of interest and spheres of influence. For example, the China player deployed military forces to the South China Sea, one of the areas considered within their spheres of influence, to challenge the United States player's presence in East Asia.[21]

Unlike the Russia and China players, the Southwest Asia and India players made small attempts to adapt to and mitigate climate change. The Southwest Asia player invested in water stress adaptation, and the India player tried to reduce emissions by investing in renewable energy. Their efforts, however, were quickly negated by the lack of investment in emissions reductions by the players whose countries had emitted greater amounts of greenhouse gases.

While China and Russia's players were focusing their attention on matters that would benefit them, the European Union and United States players initially took on the majority of foreign aid and food and fuel security needs. The other players contributed little to these aid efforts, choosing domestic development over global stability. As the game progressed and the China player continued to make military advancements, the United States player felt the need to match these investments to avoid falling behind. Similar to the progression of Game 3, an arms race emerged. To increase military spending, the United States player revised their foreign aid strategy. Rather than immediately responding to unrest, the United States player waited for the situation to escalate before providing aid. In addition, the United States player deployed forces to the Southeast Asia region in response to the China player's presence in the South China Sea.

Similar to the United States player, the European Union player changed strategies during the game. Initially, the European Union player's actions mim-

icked Games 1, 2, and 3; the player asked others, especially the China player, to engage internationally through foreign aid and climate mitigation and adaptation efforts. But once the United States player changed strategies, the European Union player became an isolationist who gave up on eliminating unrest and mitigating climate change and acted aggressively toward migrants. Arguably, the European Union player, who had been an advocate for cooperation, climate mitigation, and stability earlier in the game, was forced into this extreme position by the other players' choices. Eventually, Game 4 reflected the characteristics of Game 3.

Unlike the participants representing the larger countries, the Southwest Asia and India players made small attempts to adapt to and mitigate climate change. The Southwest Asia player invested in water stress adaptation, and the India player tried to reduce emissions by investing in renewable energy. Their efforts, however, were quickly negated by the lack of investment in emissions reductions by the players that emitted greater amounts of greenhouse gases. Thus, it became evident that leadership of the larger countries might be a prerequisite to effecting larger stewardship activities.

Findings and Risks

Based on the players' decisions and wider discussion during the scenario-planning session, we identified four areas where climate change may affect future outcomes in ways that have not been associated with climate change in the past. We organized these findings based on their prominence in the game and scenario-planning discussions:

1. Climate change may trigger increased nationalism and policies of internalization in developed countries.
2. Large-scale, climate-induced migration and displacement has the potential to impact a country's international policies, economic situation, and other defining cultural attributes.
3. Competition for limited resources may increase as a source of friction and shape policies and international relations.
4. The consensus and control of climate-related technologies may result in an emerging disparity between regions, as not all countries view these technologies in the same way and there is little framework for their use or management.

In this section, we discuss each of these findings in detail, first by linking them to player decisions and game play, then by incorporating the points raised during the scenario-planning session, and finally, by stating why we feel there is a risk associated with each finding.

Nationalism and Governance

In all four games, policies of internalization surfaced. In each game, at least one player, and up to five players in some games, decided to put forth nationalistic policies when running his or her country or region. These players did this to concentrate on internal problems as climatological conditions worsened. Players who internalized their efforts felt that their national goals, objectives, and citizens were more important than providing aid to regions in need. In one game, the player representing India invested solely in their country's energy, water, and military security for several decades, ignoring the needs of other regions in the world. In multiple games, players representing China refused to provide foreign aid out of concern that they could not satisfy domestic consumption of food and fuel. Other than some of the European Union and the United States players, the remaining players generally demonstrated only two exceptions to nationalistic behavior: (1) support to neighboring countries and (2) support to spheres of influence.

Most of the players representing the European Union and the United States consistently invested abroad through foreign aid and occasionally through military intervention to quell terrorism. In one game, for example, the European Union player deployed military forces to North Africa to fight terrorism and insurgents. In general, the players who offered foreign assistance seemed to limit their aid to neighboring countries or regions within their spheres of influence, especially to nations that could provide resources or other benefits to the main player. In one game, an India player provided foreign aid to stabilize neighboring Bangladesh out of fear of cross-border migration and terrorism. The European Union and United States players also showed favoritism toward neighboring regions and those within their spheres of influence. In one game, a player representing the United States provided foreign aid to the Andes region, citing the region's natural resources and proximity to the United States as the reason for the aid.

The overall trend of internalization was present throughout most games and was exacerbated when the climate worsened. Many of the players had to deal with growing internal instability as climate change and high temperatures affected food and water supplies. In addition, many of the less-developed countries began to slip into a cycle of disruption, which in turn, generated security challenges, an increasing number of migrants, and economic displacement for players representing developing countries.[22] Eventually, the stress from significant climate change, combined with the increasing and incessant demands from failing states, led to a retrenchment among players. In one game, for example, the player representing Southwest Asia originally contributed to international aid efforts but eventually withdrew its support when it faced regional unrest.

Overall, the players in the games attended to their domestic needs first,

despite the state of the world. As a result, instability that could not be resolved by a single player was a constant factor across all four games. While global stability could have been accomplished through international cooperation and consistent distribution of aid, most players did not turn to traditional, international governance structures to achieve this goal. Participants in all four scenario-planning discussion groups conferred with each other about this potential rise of nationalism and shift in governance, raising concerns about the possibility of needing to change governance structures as a result of added pressures and nationalist policies.

Participants highlighted several possible changes to existing governance structures that could occur as a result of the inability of these structures to resolve global challenges: the failure of regional or global arrangements, such as the European Union; the failure of individual states; and the rise of nonstate actors, such as private corporations. In the case of the European Union, multiple participants during the scenario-planning session hypothesized that the stresses of migration, energy, security, and climate impacts could push some countries in the European Union toward policies of nationalism. Participants suggested that such actions would lead to the disaggregation of the European Union. As for possible nonstate actors, participants in the scenario-planning session discussed that private corporations typically operate in their own interests, and suggested that corporations may be one of the biggest influencers of climate-related decisions in the future. In addition, they highlighted the fact that many private corporations employ highly trained security providers.[23] Given how many private corporations combine economic influence and military-like security, some participants identified private corporations as potential nonstate actors who could rise up as the result of failing states.

Based on game play and the discussions that came out of the scenario-planning sessions, we saw the potential for climate change to affect the way that countries govern and think about human rights and social justice. We identify these factors as big risks since they are something that people do not anticipate, and they have the potential to lead to additional conflict and suffering. The assumption that a major power, such as China, the European Union, or the United States, will come to the aid of those regions in need may no longer be valid if climate change causes a shift in a country's international policies. Two potential reasons that may prevent them from providing aid to foreign regions are that they may be overwhelmed by the volume of aid required or they may face internal instability. In addition, the emergence of new government structures, resulting from either the failure of global arrangements or the failure of the states themselves, could impact available aid. As the need for foreign aid increases and the number of countries that are able and willing to provide sup-

port decreases, difficult decisions will need to be made regarding which regions will receive aid and which will not.

Migration and Displacement

Migration and displacement surfaced in all four games, and these topics were discussed in all of the scenario-planning sessions. In the games, migration and displacement were caused by various factors including, but not limited to, food shortages, water shortages, and financial instability, all of which generated unrest. When there was sufficient unrest in a country, people would migrate.[24] Some examples of migration in the games were people moving from Bangladesh into India, from Central and South America to the United States, and from Africa to countries in the European Union. Climate change contributed to the increase in migration during the games because, as the temperature rose, there was greater food and water insecurity.

As we saw with foreign aid in the previous section, there was little to no cooperation or negotiations between players to resolve migration or displacement. Players whose countries were affected by migration had a decision to make: would they reallocate resources away from national goals or international outreach efforts, seek other means of dealing with migrants, or ignore the issues caused by migrants and allow unrest to spread?[25] Players chose different paths depending on the availability of resources and how they thought their country would react to migrants. The majority of the time, these decisions were made in isolation and without assistance from other players.

Not only did players tend to make decisions in isolation, they vacillated between domestic and international actions based on the needs of their nations. Early in the games, players tended to focus on internal matters before shifting their attention to foreign aid requirements. When outside regions experienced food and water insecurity, and players failed to mitigate shortages, these insecurities led to unrest, which eventually led to migration. This migration then imposed costs on the receiving countries, which had to provide additional food, water, and shelter. Around the midpoint of many of the games, the demands of migrants resulted in the retrenchment and increased isolation of many of the players representing developed countries. This may be the most significant result we saw in the games because it suggests that, as climate change grows more severe, isolation and retrenchment among the richest parts of the world could increase dramatically.

Migration clearly had an impact on the players of the game, and participants in the scenario-planning sessions also broached the issue. They voiced concerns about the potential for unrest and violence caused by anti-immigration sentiments and xenophobia, citing that large influxes of migrants could result

in significantly different social norms and cultural clashes. Participants also expressed concern about the ability of countries to provide the necessary resources for migrants.

As a result, we identified migration as a significant security risk since migrants, both internal and external, affect the economics, religion, and politics of their adopted countries. Economically, an influx of migrants increases food, water, and shelter requirements, imposing greater financial burden on the government. As we saw in the games, such pressures destabilize countries because they are often unable to provide services to the increasing number of migrants. We also saw some countries internalize by either decreasing foreign aid or by closing their borders to maintain stability.

From religious and political perspectives, participants in the scenario-planning session discussed how differing views may lead to the emergence of rogue states, alter the composition of states, or cause a shift in governance. This could result from the actions of migrants themselves or from terrorists and insurgents who take advantage of migration to carry out acts of violence that further destabilize regions and delegitimize governments. These actions could cause a shift in the cultural and social dynamics of a state. Countries with the means to assist incoming migrants, whether through financial aid or opening up of borders, may choose not to do so because they fear internal economic, social, or political instability.

Resource Competition

We identified the competition for resources and the means by which states attempt to meet their needs as a security risk for multiple reasons. First is the increasing divide between the haves and the have-nots. Presently, many countries are resource insecure. Due to climate change, the situation in those countries will likely worsen, leading to further destabilization of states. In comparison, many countries that are relatively resource stable may be less likely to feel severe consequences from climate change. In all four games, meeting food, energy, and water requirements was a major concern for players. In the early stages of game play, resource shortages plagued regions that were already resource insecure. As each game progressed and temperatures increased, more players faced issues related to water scarcity, the availability of arable land, and increasing energy requirements. The idea that already resource-scarce areas will feel the effects of climate change first reinforces the potential for an increasing divide between regions with sufficient resources and those without.[26]

The second reason is the potential for countries to depend on global markets to meet domestic resource requirements, which is problematic considering future constraints may be placed on global markets due to climate change or geopolitical tensions. As discussed during the scenario-planning session, there

is the potential for negative consequences on countries that depend on global markets to meet domestic needs if the markets fail. Many players chose to internalize to stabilize their countries. In some of the games, players who faced shortages chose to invest in engineered crops, water conservation technologies, and exploiting the Arctic for natural resources (i.e., minerals), but generally, the players were unwilling to share resources. In only one game did players agree to an alliance over sharing resources; however, their mutual cooperation only lasted for a few turns of the game.

The third reason is that the potential competition between countries and regions over natural resources is also a risk. Declining availability of raw materials, food, and water could increase tensions and energy disputes between countries attempting to obtain or fighting to maintain control over these resources. Such disturbances would be comparable to those currently taking place in the South China Sea. Rising global temperatures may threaten food and water resources as well as arable land around the world. Without sufficient resources, there is the potential for state instability and even failure. Interestingly, we did not see any players use military force to invade a region and gain control of the region's resources. In only one game did players come close to outright aggression when those representing the United States and China competed for Brazilian mineral rights to meet domestic consumption. The players chose not to use military force, but did commit substantial financial resources to gain access and control.

Finally, in multiple scenario-planning discussion groups, participants identified the potential for competition over natural resources, both nationally and internationally, as an area of concern and possible risk. They reinforced the issue of the widening divide between the haves and the have-nots that we saw in the game; for example, players closed their countries' borders and were less inclined to provide support to regions in need. Many of the "have" players did not make any attempts to mitigate this widening divide. Participants expressed concern about the limited availability of raw materials, food, and water, which they felt could increase tensions and energy disputes between areas as countries fight to obtain or maintain control over these resources. Participants in the scenario-planning sessions also highlighted the potential for countries in need to rely heavily on markets, particularly food markets, to meet their requirements. They stated that if there were fluctuations in the market or if the markets failed completely, it could result in major repercussions for those states that depend on them for resources. Participants noted that the failure of markets, in combination with the already short supply of resources, could lead to state failure. In real time, these are consequences that should be taken into consideration by nations as they examine their policies regarding climate change, humanitarian aid and disaster relief, and overseas investments.

Consensus and Control of Technology

In response to climate change, we saw two of the four games turn to technology to deal with rising temperatures and greenhouse gas emissions. The two dominant forms of technology across the games were nuclear energy and geoengineering. Both of these perceived solutions come with security risks as discussed below.

In one game, the player representing India turned to nuclear energy to reduce greenhouse gas emissions. The players in this game felt it was a viable alternative to fossil fuels. The European Union player supported the India player's actions by investing in nuclear energy. Unfortunately, as we saw in numerous games, the actions by one or two players were not sufficient to offset global emissions and, as a result, global temperature continued to rise.

The continual rise of temperature and increasing severity of climate change in the games also drove some players toward geoengineering, which one set of players saw as a first choice while most saw it as a last resort. All of them were balancing the perceived risks from geoengineering with the increasing risks from loss of governance, national isolation, and resource depletion (e.g., food, energy, and water). About the time that donor fatigue began setting in, these risk curves crossed and geoengineering became more attractive despite the defined risks that were incorporated into the game. Not all players in the games were comfortable with the use of these technologies, specifically geoengineering, since the costs, benefits, and risks are not well understood. Players with technical expertise, however, felt that the benefits outweighed the risks and they proceeded with implementation in those games.

Questions over the control, use, and implementation of geoengineering also surfaced during the scenario-planning discussions as participants echoed the concerns that had been raised during the games. During the scenario-planning session, participants were less concerned about the impacts of increased nuclear energy than those attributed to geoengineering. They did, however, acknowledge that nuclear energy could be weaponized by terrorists or nation states. Furthermore, as demonstrated by the Fukushima nuclear power plant meltdown caused by a tsunami in 2011, nuclear power plants are still vulnerable to accidents.

While the risks associated with implementing technologies, such as geoengineering, are largely unknown, we observed a potential risk related to governance. In the games where geoengineering was implemented, players discussed who had the authority to approve the use of this technology and what requirements should be in place before the technology can be used. Interestingly, geoengineering was one of the few examples that brought the players to engage in multilateral decision making in one of the games. There was, however, a lack of consensus and control surrounding geoengineering elsewhere. This lack of

consensus and control over the use of technologies is a potential security risk. As we observed in the games, without guidance from the international community, nothing prevents a country, region, corporation, or individual from attempting to implement this technique. As climatological conditions worsen, these entities may take it upon themselves to implement this technique with or without approval. Then, it would be incumbent upon all the countries to maintain this geoengineering effort for fear of backsliding.[27]

Conclusion

The four findings and risks highlighted in this article capture some of the big issues that could arise as a result of climate change. We saw interplay between nationalism, limited resources, the possibility of failing states, and the authority to act. The combination of four games and four scenario-planning discussion groups provided an opportunity to identify and discuss the risks that climate change poses to human security. The structure of the event gave participants a chance to discuss various circumstances and identify issues by hypothesizing in a structured environment. The experience and knowledge of the high-ranking participants from different countries was integral to the event and allowed us to explore the foremost climate-related risks. As a result, participants created a virtual world wracked by extreme weather, surging migrant groups, unclear nation agreements, and possible terrorist activity to help policy makers understand the consequences of various actions. Considering that global leaders are already dealing with these conditions piecemeal, the outcomes are plausible and useful for policy makers considering future action.

As the effects of climate change increase, some countries may begin to internalize and put forth nationalistic policies; however, countries that do not internalize may find themselves responsible for aiding larger regions around the globe. Eventually, there may be insufficient resources to support regions in need. Participants suggested that stretching resources too thin may result in an emergence of new government structures, resulting either from the failure of global arrangements or from the failure of the states themselves. Internal and external migration has the potential to change the way that countries operate, how their people view the world, and how their leaders respond to crises. The impact on a particular country or region's outlook toward the global commons, its neighbors, and its own people may have negative consequences for humanitarian aid, security, and the ability to mitigate and adapt to climate change.

In the future, limited resources—food, energy, and water—may force countries and regions to seek alternative pathways to meet their needs. Two such pathways are relying on global markets and assuming policies of internalization, both of which have underlying risks.

As the pressures from climate change increase, countries, regions, organi-

zations, or individuals may turn to such technologies as nuclear energy and geoengineering to mitigate the effects of climate change. Without consensus and control from the international community on managing these and other new technologies, these techniques could be implemented before their effects—both intended and unintended—are fully understood.

Today, these risks may not seem like risks at all as we have yet to feel their impact. However, as the global temperature increases and climate conditions worsen, countries and regions may feel, as indicated by this research, an increased pressure to take action. By recognizing these risks today, countries and regions can be prepared to mitigate these effects in the future. Solutions to the challenges posed by these risks and identifying ways to work through them may not be immediately obvious and could take time to develop. By taking action now, whether it is to better understand the consensus and control of technologies or to mitigate climate change itself, we may be better prepared for the future. While not all of these risks are of immediate concern, decisions made today will drive the pathways we are able to take in the future.

Notes

For the purposes of this discussion and to align with the goals of the game scenario, we use gender neutral pronouns (e.g., they, their) throughout.

1. David King et al., *Climate Change: A Risk Assessment*, ed. James Hynard and Tom Rodger (Cambridge: Centre for Science and Policy, 2015), http://www.csap.cam.ac.uk/media/uploads/files/1/climate-change--a-risk-assessment-v10-spreads.pdf.
2. For additional information on gaming, see David Michael and Sande Chen, *Serious Games: Games that Educate, Train, and Inform* (Independence, KY: Cengage Learning, 2006).
3. Given the importance of the event and seniority of the participants, CNA executed a test run of the game and scenario-planning sessions at CNA Headquarters in the Washington, DC area on 12–13 February. Fourteen people, including representatives from CEEW, FCO, and SGTF as well as subject matter experts, participated in the test run.
4. The phrase *peer competitor* is a U.S. expression that refers to the group of advanced, nuclear-capable countries that can sustain high-intensity combat operations.
5. In the games where geoengineering was implemented, we assumed that it was done in the form of stratospheric aerosols that had to be continuously implemented and maintained throughout the game to sustain the effects.
6. Migrants in the game represented millions of displaced persons occupying a large area and consuming considerable resources. In the game, we did not differentiate between migrants and refugees. "Migrant/Migration," United Nations Educational, Scientific and Cultural Organization (UNESCO), 21 October 2015, http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/migrant/; and "Refugee," UNESCO, 21 October 2015, http://www.unesco.org/new/en/social-and-human-sciences/themes/international-migration/glossary/refugee/.
7. For an in-depth discussion of the different Intergovernmental Panel on Climate Change's (IPCC) emission pathways, please see Matthew Collins et al., "Long-Term Climate Change: Projections, Commitments and Irreversibility," in *Climate Change 2013: The Physical Science Basis*, ed., Thomas F. Stocker et al. (Cambridge: Cambridge University Press, 2013), 1029–1136; IPCC, "Summary for Policymakers," in *Climate Change 2013*, 3–32; and

IPCC, "Annex II: Climate Systems Scenario Tables," in *Climate Change 2013*, 1395–1446.

8. A turn represented a step in time. During a turn, all the players would have to make certain decisions simultaneously, which is discussed in additional detail later in the article.
9. One game controller was assigned to each of the four games to walk players through each turn, answer questions, capture the players' decisions, provide outcomes of those decisions, and fulfill a few other responsibilities during the game.
10. "Quick Facts: What You Need to Know about Super Typhoon Haiyan," *MercyCorps*, 14 November 2013, https://www.mercycorps.org/articles/philippines/quick-facts-what-you-need-know-about-super-typhoon-haiyan.
11. Elizabeth Frankenberg, Duncan Thomas, and Jed Friedman, "Resilience and Recovery Ten Years after the 2004 Indian Ocean Tsunami: A Summary of Results from the STAR Project," *Impact Evaluations* (blog), World Bank, 18 December 2014, http://blogs.worldbank.org/impactevaluations/resilience-and-recovery-ten-years-after-2004-indian-ocean-tsunami-summary-results-star-project; and David R. Marples, "Chernobyl," Encyclopedia of Russian History, 9 June 2016, http://www.encyclopedia.com/topic/Chernobyl.aspx.
12. The simplified relationships between climate and resource variables used in the game model were reviewed by the Climate Change Science Institute of Oak Ridge National Laboratory. Sylvia Lee, e-mail to Simon Sharpe and Jay Gulledge, 25 February 2015.
13. "World Factbook, 2013–14," Central Intelligence Agency, 4 June 2015, https://www.cia.gov/library/publications/the-world-factbook/index.html; "World Bank," World Bank, 31 December 2014, http://www.worldbank.org/; and "World Population Prospects: The 2012 Revision," UN, Department of Economic and Social Affairs, Population Division, 4 June 2015, http://esa.un.org/wpp/.
14. Collins et al., "Long-Term Climate Change"; IPCC, "Summary for Policymakers;" IPCC, "Annex II: Climate Systems Scenario Tables"; Claudia Tebaldi et al., "Going to the Extremes: An Intercomparision of Model-Simulated Historical and Future Changes in Extreme Events," *Climatic Change* 79, no. 3 (2006): 185–211, doi:10.1007/s10584-006-9051-4; "World Statistical Data," FAOSTAT, Food and Agriculture Organization of the United Nations Statistics Division, 4 June 2015, http://faostat3.fao.org/home/E; Katy Richardson, *Human Dynamics of Climate Change: Technical Report* (Exeter, UK: Met Office, 2014), http://www.metoffice.gov.uk/media/pdf/n/d/HDCC_technical_report.pdf; Charles J. Vörösmarty et al., "Global Water Resources: Vulnerability from Climate Change and Population Growth," *Science* 289, no. 5477 (2000): 284–88, doi:10.1126/science.289.5477.284; Kate Gordon, *Risky Business: The Economic Risks of Climate Change in the United States* (New York: Risky Business Project, 2014), http://riskybusiness.org/site/assets/uploads/2015/09/RiskyBusiness_Report_WEB_09_08_14.pdf; "*Human Development Index (HDI)*," UN Development Programme, 3 June 2015, http://hdr.undp.org/en/content/human-development-index-hdi; and IPCC, "Summary for Policymakers."
15. Because water variability ranges from drought in some parts of the world to flooding in others, we characterized water variability as a measure of these swings in water effects.
16. The climatological conditions described in the materials were mainly based on the IPCC's fifth assessment report and related research documents cited earlier. The assumptions used in the scenario-planning session documents were reviewed by the Climate Change Science Institute of Oak Ridge National Laboratory. See Lee e-mail.
17. This test run was executed over two days, but we ran two separate player groups through the game and held two scenario-planning sessions rather than four.
18. Players could propose other investment options if they wished.
19. There was a mutual agreement among these players as to which regions they would provide assistance.
20. In the game, when players wanted to implement geoengineering, they had to roll the dice to account for the potential of unintended negative consequences. Players had a 5 percent chance of their implementation going awry. Since stratospheric aerosols have

to be continuously implemented, the implementing player had to roll every turn to see if there were any negative consequences, thus increasing the nation's probability to suffer risks.

21. Given the United States' relationship with Japan and other East Asia countries, the U.S. player had military forces in East Asia as part of the starting conditions of the game.
22. In the game, some of the countries and regions were in a state of constant unrest, which occurred when the players did not continually mitigate issues that arose.
23. Group 4 Securicor (G4S), for example, is the largest security solutions provider in the world; it operates in more than 110 countries. "Key Facts and Figures," G4S, 1 June 2015, http://www.g4s.com/en/Media%20Centre/Key%20facts%20and%20figures/.
24. As part of the game mechanics, when a migrant relocated to a given player's country, the country saw increased costs and unrest.
25. As part of the game mechanics, if players did not mitigate the issue causing the unrest, the unrest would continue to grow and spread. Similarly, if the issue causing the unrest also caused people to migrate, additional migrants would be generated until the issue was resolved.
26. Recall in Game 3, for example, the Southwest Asia player did not have sufficient food resources to meet their needs and therefore threatened to invade North Africa if they did not receive assistance.
27. Assuming geoengineering is implemented through the use of stratospheric aerosols, it must be continuously maintained. There is the perceived risk that if these aerosols are not sustained, global temperatures could rebound or rise even higher.