# OMEGA RISK: ANALYSIS OF EVENTS WITH LOW PROBABILITY AND CATASTROPHIC IMPACT ON THE GLOBAL ECONOMY

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***Abstract:*** *This study explores the idea of "Omega risk," which is defined as occurrences with a very low likelihood but possibly disastrous effects that might cause the world's GDP to drop by more than 50% in 10 years. Our world has changed due to the unprecedently fast speed of scientific and technical breakthroughs, which presents both enormous potential and hazards. Once confined to science fiction, innovations like artificial intelligence, space travel, gene editing, and microrobots today bear the potential for catastrophic outcomes including AI dominance, global pandemics, extraterrestrial contact, and climatic calamities. Risk is a natural part of economic activity and is usually classified according to likelihood and impact. But conventional financial models, which assume endless operation without taking catastrophic occurrences into account, frequently ignore these low-probability, high-impact hazards. With an emphasis on risk identification, the first stage of risk management, this article seeks to start a conversation about these high-impact, low-probability hazards from an economic standpoint. By combining ideas from science fiction literature with conventional scientific analysis, the research takes a novel technique to provide a more thorough assessment of Omega dangers. These risks are divided into five categories: biological (such as genetic engineering, resuscitation of extinct species), technological (such as artificial intelligence development, internet malfunction), environmental (such as climate change, volcanic eruptions), social (such as nuclear devastation, collapse of society), and cosmic (such as impacts from asteroids, encounters with extraterrestrial life). This article aims to encourage more extensive debates among economists, policymakers, and other stakeholders by broadening the scope of risk identification.*

***Key words:*** *catastrophic risk, existential risk, risk identification, artificial intelligence,*
***JEL codes:*** *Q54, G01, Y80, D81, F65*

## 1. Introduction

The unprecedented pace of technological and scientific advancements has reshaped our world, bringing both remarkable opportunities and significant risks. Innovations such as artificial intelligence, space travel, gene editing, and microrobots, once relegated to science fiction, are now part of our reality and carry potential catastrophic consequences, including AI domination, space-borne diseases, global pandemics, alien contact, and climate disasters.

Risk is a necessary component of economic activity and can be grouped according to probability and impact. This work focuses on discovering "Omega risks," or risks with extremely low likelihood but possibly significant economic consequences. Even though each risk is unlikely on its own, when together, they have a substantial potential to affect both humanity and the global economy. Such risks are frequently ignored by traditional financial models. The goal of this paper is to start a conversation on these high-impact, low-probability dangers from an economic standpoint, with an emphasis on how to identify and categorize them.

The following steps form the foundation of the financial risk management methodology: identification, measurement, analysis, response planning, response plan implementation, process monitoring and evaluation. This work focuses on risk identification, which is the initial phase in the process. The identification involves the studying of literature and classification in categories. For each categories examples are provided.

## 2. Methodology

The subject of the study is a risk that could cause a very deep economic collapse. In economic literature, there is no precise term that would describe this phenomenon. The closest term that fits the subject of the study is - existential risk, defined by the Stanford Existential Risk Initiative (www1) as a risk that can cause the collapse of human civilization. According to Future of Life (www2), existential risk is any risk that has the potential to eliminate all of humanity or, at best, kill large parts of the global population, leaving survivors without sufficient means to rebuild society to current standards of living. From an economic point of view, this definition seems insufficient because it focuses on the extinction of humanity, not economic phenomena. It is possible to imagine catastrophic economic effects that are not directly related to the extinction of humanity, e.g., the collapse of the financial system or a global internet outage.

Another term describing risk that is difficult to predict and has catastrophic consequences is "Black Swan," most often associated with statistician Nassim Taleb. However, according to Nassim Taleb, this term is a metaphor describing unpredictable events with a major impact on

the world, which are difficult to predict before they occur but easy to rationalize after the fact (Taleb, 2007). Another term describing the risk that is the subject of this study is catastrophic risk, which is defined as a risk causing serious harm to human well-being on a global scale (Bostrom & Ćirković, 2011). This definition of risk with a very low probability of occurrence and a very large impact on human economic activity may be useful for economists. However, this definition lacks precision in what it means by serious harm to well-being on a global scale.

For the purposes of this study, 'catastrophic risk' is defined as an event that could cause global GDP to fall by more than 50% from the peak to the lowest level in a period shorter than 10 years. Catastrophic risk defined in this way will henceforth be referred to as Omega risk.

It is difficult to find events in modern history that have occurred in the past and had a similar economic impact. During the Great Depression between 1929 and 1932, global GDP fell by 15% (Eichengreen, 2014). GDP declines of more than 50% in a period of less than 10 years occurred regionally in European countries during World War II (Bolt & Van Zanden, 2020).

Events that can be classified as Omega risk have occurred in the past. Certainly, we can include the event from 60-70 thousand years ago, when humanity faced the risk of extinction (population decline from 100,000 to even 3-10,000). The collapse of the human population in a short time is most often explained by the eruption of the supervolcano Toba (Rampino & Ambrose, 2000). It is worth noting that, according to the definition, a slow reversal of the trend in human development caused by low fertility would not also be an Omega risk—due to the fact that the decline would not be sudden, but would occur slowly.

One of the most popular methods of risk identification is the PESTLE method. It involves identifying risks in individual categories P – Political, E – Environmental, S – Social, T – Technological, L – Legal, E – Economic. Then, the person identifying risks, based on their own experience, knowledge, current information, and imagination, tries to identify possible risks in each of these categories.

Given that the subject of this study is the identification of risks with a very low probability and a very large impact on economic activity, the application of the above methodology may not be effective. It is difficult to imagine legal risks that would in themselves generate a risk of destroying people. Additionally, using one's own imagination to identify risks with a very large impact may be difficult and associated with numerous limitations. For this reason, in addition to applying the analysis of available research, we propose using a methodology that is not often used in economic sciences, namely—the analysis of science fiction literature and films to

identify these risks. Complementing the traditional method—analysis of scientific research with an analysis of science fiction literature and films—will allow for a more complete identification of Omega risk. This method will allow for the innovative use of the centuries-old body of novels and science fiction films to identify possible risks.

## 3. Results and Discussion

After analyzing the literature and risks associated with individual areas, a classification of identified risks was made, and the main risks from each area were discussed.

**Tab. 2** Classification of Omega Risks

| Risk type | Examples |
|---|---|
| **Biological** | Genetic modification – virus |
| | Evolution of another species |
| | Vaccine with delayed side effects |
| | Revival of an extinct species |
| **Social** | Nuclear annihilation |
| | Collapse of the social system |
| | Third World War |
| **Technological** | Internet failure |
| | Evolution of Artificial Intelligence |
| | Nanotechnology |
| | Computer virus |
| | Technological addiction |
| | Physical experiment |
| **Environmental** | Climate change |
| | Volcanic eruption |
| | Earthquake |
| **Cosmic** | Encounter with an alien civilization |
| | Impact of an asteroid, comet on Earth |
| | Electromagnetic and gravitational waves |

Source: Own creation

Biological risk is related to the interaction of biological factors. Below are various biological factors that can cause phenomena with catastrophic consequences. Genetic modification is a factor that may entail risks associated with creating organisms that threaten the economic activity of people and the very existence of humans. Attention should be paid to the novel "Oryx and Crake" (Atwood, 2004). In this novel, genetic experiments and

modifications lead to the creation of a pandemic designed to reduce the human population. Atwood presented the risks associated with genetic engineering and its unpredictable consequences, highlighting the dangers associated with striving to "improve" nature at all costs. Several years after the book was published, a global coronavirus pandemic erupted, which could have been the result of genetic modification. Advances in biotechnology, such as genetic engineering, pose significant risks if not properly regulated, potentially leading to unintended ecological impacts and new forms of bioterrorism (Esvelt & Smidler, 2018).

Reactivating an extinct species of bacteria, animal, fungus, or plant may have far-reaching consequences. This is not just a hypothetical example, but an event that we are increasingly dealing with. An example could be the revival of an extinct species of Israeli date palm 2,000 years ago. Archaeologists found seeds of a long-extinct species of date palm tree in one of the kitchen rooms. Out of several dozen seeds, six were active after 2,000 years and were able to be revived—trees arose from them. The process of reintroducing them into the ecosystem is currently underway (Gros-Balthazard et al., 2021). Introducing such an organism back into the ecosystem may pose a threat to humanity. We do not know how our bodies and the entire ecosystem will react to the introduction of a long-extinct species. The accelerated evolution of another species by human experiments is another Omega risk. In the book "Planet of the Apes" by Pierre Boulle (1963), astronauts land on a distant planet where apes are the dominant species, and humans live in a wild state. The story explores the consequences of the evolution of another species to a level dominating over humans, prompting reflection on our place in the world and inter-species relationships. In the adaptation of the book and subsequent parts of the series, the possibility of accelerating the evolution of apes through human activity is presented. Delayed side effects of a medicine given to combat another disease represent another biological risk caused by humans. In the book "I Am Legend" by Richard Matheson (2007), a scientist is portrayed as the last survivor in New York after a cancer cure transformed humanity into vampire beings. The exploitation of genetic modification leads to an unintended pandemic, underscoring the risk of insufficiently tested genetic therapies. For example, mRNA vaccines, such as those for COVID-19, represent a new technology with unknown long-term safety profiles, necessitating ongoing surveillance for adverse effects (Polack et all., 2020).

Social risk concerns the relationships between groups of people. Usually, these are deliberate actions to destroy the opponent, but one cannot exclude the element of chance or an inherent characteristic of people that leads to collapse. Nuclear annihilation, as a risk with potentially catastrophic consequences, was often discussed during the Cold War. There is

currently a system of agreements and procedures that are intended to reduce this risk. An example could be the commitment that neither the USA nor Russia would use nuclear weapons against the other side first. However, it is not difficult to imagine a situation where the opponent's movements are misinterpreted or a foreign country is bombed by mistake. In the science fiction film "Dr. Strangelove" by Kubrick (1964), a series of bizarre mistakes led to the annihilation of humanity. Just two years after the debut of this surrealistic film, in 1966 in the USA, Spain was accidentally bombed with nuclear bombs. As a result of the accident, an American bomber dropped four nuclear bombs on Spain (Megara 2006). Fortunately, the explosive charges did not explode or exploded defectively—leading to "only" radioactive contamination of Spanish beaches. A similar case occurred in 1995 when the former President of Russia, Boris Yeltsin, was close to launching nuclear missiles after receiving information that a nuclear warhead had fallen on Russia. That rocket turned out to be a Norwegian space satellite (Forden, 2001). It is likely that there were significantly more such events, but not all of them made it to public opinion. World War III is another event worth discussing separately when identifying Omega risk. Even assuming that nuclear weapons and other prohibited types of weapons, such as chemical or biological, would not be used, the consequences of such a conflict could be far-reaching in terms of economics, politics, and society. An attempt to describe World War III as a conflict dominated by cyberwarfare and modern technologies, such as drones and robots, was made in the novel "Ghost Fleet: A Novel of the Next World War" by Singer and Cole (2015). The collapse of the social system is another event that can lead to serious economic consequences. To be recognized by us as Omega risk, the event must have destructive effects on the economy in a relatively short time (below 10 years). Social changes usually occur slowly, but as society becomes increasingly globalized, social changes may occur faster. An example of such an event, which, admittedly, does not meet the criteria for Omega risk due to the slow process, is the fall of the Roman Empire. Although the fall lasted for a longer time, it is worth analyzing history to imagine the consequences of such an event. During the Middle Ages, science regressed, the economy collapsed, life expectancy shortened, cities depopulated, and the ability to write and read declined. In his six-volume analysis, Gibbon (1840) explains the fall of the Roman Empire as the loss of moral values represented by society.

Technological risks are associated with technology created by humans, both with hardware and software. Information technology is one of the fastest-growing parts of the economy in recent times. Countless innovations are emerging here that may carry serious risks. A permanent internet outage is one of the more serious risks that could cause the economy to

collapse. If the internet were to stop working, some alternative systems would certainly appear. However, the event itself could reduce the global economy by more than 50% for many years. Risks arising from a global internet outage can be divided according to the cause: unknown technical problems, cyberattack, attack on key infrastructure (Madiega & Luca, 2023). The evolution of artificial intelligence also poses a very serious threat to humanity. Emerging technologies, including AI, pose existential risks by enabling new forms of terrorism - AI could potentially be used by terrorists to create catastrophic events, such as hacking into critical infrastructure or developing autonomous weapons (Ackerman & Kallenborn, 2023). Advances in artificial intelligence (AI) could exacerbate existing social inequalities and lead to significant economic instability (Rahwan et al., 2019). Nanotechnology and self-replicating mechanisms are other factors that can cause Omega risk. It is possible to imagine microrobots that replicate themselves and consume all the resources in the world. Such a self-replicating mechanism could be created by an individual for fun, a terrorist group, an army, a scientific experiment that gets out of control, or the aforementioned artificial intelligence. The hypothetical scenario called "gray goo" was described by Drexler (1986). In this scenario, microrobots capable of self-replication would begin to consume all available materials on Earth in order to create more copies of themselves, leading to the destruction of ecosystems and even the possible extermination of humanity. A computer virus is an example of another risk with very significant economic implications. Computer viruses are most often created by hackers to steal information, obtain ransom, or for terrorist purposes. However, as a result of the transfer of hundreds of billions of data, one can imagine the emergence of such a virus spontaneously. Such a virus would be able to evolve and would be resistant to all antivirus programs. Technological addiction can also be considered a potential tragic risk. Currently, technology corporations are competing to produce increasingly addictive games, social media platforms, and other systems. Thanks to appropriate mechanisms, programs stimulate continuous dopamine release, which clearly leads to addiction. With the development of these systems, one can imagine increasingly addictive social media platforms and games that would cause addiction as strong as, or even stronger than, drugs such as heroin. A failed physical experiment is a frequently discussed topic that could cause a global catastrophe. Physics as a science is not finished, which means that there are many unknowns—especially in the field of quantum physics. A case of a failed physical experiment could be the creation of a black hole that begins to grow and destroys the world. In the case of physical experiments, such as those conducted at the Large Hadron Collider (LHC) at CERN, there were concerns about potential existential

risks, including the possibility of creating microscopic black holes. However, in light of current theoretical scientific knowledge, such events are considered very low or even theoretical. A slightly greater risk may accompany the Relativistic Heavy Ion Collider (RHIC)—it has been estimated by Martin Rees (2003) at at least 1 in 50 million. A similar risk accompanied the explosion of the first atomic bomb, many scientists expressed concern about possible effects. Among many existential risks, the most frequently mentioned was the initiation of a chain reaction that would destroy life on Earth—however, theoretical calculations showed that the risk of such an event is small (Wiescher & Langanke, 2024).

Environmental factors can also lead to the occurrence of Omega risk. Disasters related to the environment are easier to imagine than previously discussed because they have already occurred in the past (eruptions of supervolcanoes). Climate change is predicted to cause extreme weather events and sea-level rise, which could lead to economic damages amounting to trillions of dollars (Kemp et all., 2022). However, anthropogenic global warming, which will last for decades—and as such, is unlikely to cause Omega risk. However, due to various connections, it may gain significant momentum. Such a situation was presented in the film "The Day After Tomorrow" directed by Roland Emmerich (2004). In the film, due to a series of factors, a global ice age suddenly occurs, leading to the death of many people in a short time. Volcanic activity can have catastrophic consequences for human civilization. The strength of a volcanic eruption is measured using the Volcanic Explosivity Index (VEI), which classifies eruptions from 1 to 8 based on the volume of volcanic mass emitted. Type 8 explosions in the VEI scale occur approximately every 50,000 years, such an explosion could block access to sunlight on Earth for many years (volcanic winter). Such an event affects the entire globe (Lara, Tzachir & cole, 2021). The last such explosion occurred 74,000 years ago and is known as the Toba Catastrophe (Indonesia). The amount of volcanic ash resulting from the eruption was so large that it covered India, thousands of kilometers away from Toba, with a layer of ash reaching 15 centimeters. The volcanic winter lasted from 6 to 10 years, and changes in the Earth's climate lasted for over 1,000 years. Genetic studies suggest that the number of our ancestors may have decreased from 100,000 to even 3,000 individuals (Ambrose & Stanley, 1998). Earthquakes also have the potential to destroy humanity. The strength of earthquakes is measured on the Richter scale, with each subsequent degree on the scale representing an earthquake 31.6 times stronger. One of the most tragic earthquakes in history is the 2004 earthquake that occurred in Sumatra. That earthquake had a magnitude of 9.1 on the Richter scale and claimed the lives of nearly 250,000 people. According to the USGS (www3), earthquakes larger than 10 on the Richter scale are

impossible. However, a sufficiently large earthquake in combination with other factors may contribute to the occurrence of Omega risk.

Cosmic risks are a group of risks whose source is outside the Earth's atmosphere. These risks can be divided into anthropogenic (caused by human space exploration) and natural (e.g., meteorite impact). Encounters with alien life forms, including encounters with an alien civilization, can be caused in two ways: by human activity or by extraterrestrial beings. Due to the significant distances between planets, an encounter with an intelligent civilization would most likely occur through remote contact. However, such contact could also have unpredictable negative consequences. Another risk is space exploration. Increasingly bold plans to send space probes and their return raise risks of bringing some form of organism to Earth, e.g., a virus that could destroy life on our planet. Such scenarios are seriously considered by NASA and appropriately secured, e.g., by quarantine (Vick-Majors, 2022). An asteroid or comet impact could cause a years-long winter on Earth due to dust and aerosols rising into the atmosphere, which block sunlight, drastically lowering the temperature on the surface. Cosmic objects constantly collide with Earth, but only a few are capable of causing an event such as the great Cretaceous extinction, which occurred 66 million years ago and led to the extinction of 75% of animal and plant species. This event is attributed to the collision of Earth with a cosmic object about 10 km wide. NASA research (www4) indicates that within the next 100 years, we are not threatened by an impact with an object wider than 1 km. However, NASA emphasizes that there is great unpredictability (especially among further distant objects) and indicates that smaller objects (albeit with a very low probability) may hit the Earth and have a regional impact on humanity. Another type of risk is less visible - geomagnetic storms can disrupt power grids and communication networks, causing economic losses and emphasizing the need for resilient infrastructure (Estwood et all, 2017). Gamma-ray bursts, i.e., sudden increases in the intensity of gamma radiation of exceptionally great strength, could theoretically lead to the destruction of our civilization. One hypothesis about the Cretaceous extinction suggests that it was caused by a gamma-ray burst (Bostrom, 2002).

## 4. Conclusions

This work aims to initiate a discussion among economists in Poland on the topic of risk with an extremely low probability of occurrence but with a very high impact on humanity. Until now, the subject of research has been considered insignificant in economic sciences. Experiences of recent years (coronavirus pandemic, development of artificial intelligence, escalation of armed

conflicts, space exploration, genetic engineering) mean that these risks, once in the realm of science fiction, are becoming increasingly real. Moreover, discussions on these risks are conducted in other areas—among specialists in those areas, such as the risk of human annihilation by artificial intelligence. For this reason, there is a need to expand research in this area also by economists, financiers, and even insurance agents or accountants. Even if these risks seem remote and unreal, their perception can significantly influence economic activity through people's behavioral behaviors. This work introduces three new elements: the scope of research (an area that has been little studied from an economic perspective), methodological (the use of a method that has not previously been widely used in economic sciences—analysis of literature and science fiction films), and an attempt to classify Omega risks. A classification of Omega risk sources has been made: biological, social, technological, environmental, and cosmic. The topic of existential and catastrophic risks is not new, but until now, it has not attracted much attention in economic sciences. Thus, there is a large field for research by economists and financiers. Below, possible research directions in economic sciences have been identified: measuring the probability of Omega risk occurrence, adjusting existing financial and economic models for Omega risk, including Omega risk in economic decisions made by individual governments, managing Omega risk, responding to Omega risk, monitoring Omega risk, and behavioral finance and Omega risk.

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