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A SYSTEM FOR ACCOUNTING COSTS OF CONTEMPORARY NEGATIVE ENVIRONMENTAL PHENOMENA – SOME METHODOLOGICAL REMARKS

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ABSTRACT: The article contains an idea of building a cost accounting system for contemporary negative phenomena of natural and anthropogenic disasters, including ecological ones. These phenomena are treated as "black swans", that is, phenomena with a high level of threat and wide, diverse, mainly negative effects. The authors presented selected methodological suggestions for including different types of effects of such phenomena in the system of records and their monetary valorization (i.e. cost recognition). The article is intended as an introduction to further in-depth discussion of these challenges. Considering the emerging problems (phenomena and processes), they belong to the most important issues for economics, ecological economics and environmental economics. However, they are not very often addressed in the literature.

KEYWORDS: cost system, effects and costs of negative phenomena, negative environmental phenomena, black swan type phenomena

Introduction

The contemporary human civilization has arrived at a difficult point in its development, which can be called, according to the theory of deterministic chaos, the point of bifurcation, characterized by a growing significance of sensitive parameters, to an extent that is often difficult to identify. This kind of point means a situation where a civilization will make a conscious choice, or where a path of further evolution will be imposed upon it (Jakimowicz, 2017). In cybernetics, system theory, as well as in socioeconomic growth theory, many such paths are distinguished, some of which are desirable, and some of which are undesirable. Most people are not even conscious of this or evaluate the situation in a manner that is convenient to them. It can be noticed not only in everyday utterances, but also in serious scientific research. For example, in economic sciences, it is still assumed that socioeconomic issues will best be solved by a perfectly competitive market and agents such as *homo oeconomicus*, and that economic growth in the traditional form can only be regarded positively („growth mania”), (Ayres, 1998). Similarly, the following slogan is accepted without reflection: „the failures of technology will be solved by technology”.

Because most scientific works present an optimistic assessment of the perspectives of development of human civilization, even under conditions of globalization, we, as exponents of “reality-based economics” postulate that it is worth it to look at the problem of barriers to global development, and in particular at the costs of overcoming them (Becla, Czaja, & Graczyk, 2020).

The purpose of this article is to present the idea of a system of recording the costs of “black swan” events, that is events that (1) are highly unexpected, or low in predictability, (2) have a wide scope of negative consequences, which are complex and diverse, (3) have high social, economic and ecological costs tied to their occurrence, and (4) leave significantly deep marks on the human-society-economy-natural-environment system, and also have consequences that are difficult to identify, quantify, and evaluate. The notion of a “black swan” and the related type of phenomena was introduced into literature by Nassim Taleb.

The last element is of particular interest to the authors, as it appears useful and attainable with the current state of knowledge and with the functioning of global computerized information systems. It can be treated as a call to create a system of recording the costs of contemporary environmental phenomena. Such environmental threats may be treated as the best possible exemplifications of “black swan” events.

The purpose of this paper is not to quantify the size of such costs, because that is a task for large research teams with adequate economic and financial

resources to carry out the studies, with access to the appropriate sources of information, and even to an appropriate system for record keeping and statistical analysis. The authors of this paper could only afford to determine the varieties of costs that are tied to global economic challenges, and to formulate the arguments for building a system meant to record them on a macroeconomic scale.

Brief review of literature

The losses (defined as the loss of physical and/or functional qualities of something) and costs (understood as a monetary expression of expenditures for the implementation of a specific action) of natural and man-made disasters are among the most important challenges of modern economy. There are many interesting studies on this problem in the world and in Polish literature. They emphasize the need to deepen and broaden the scope and increase the precision of calculating the effects of such phenomena. The source of the needs is the issues of insurance, accounting records and accounting estimates. Three approaches can be distinguished:

- based on *a priori* accepted values, popular in insurance; an example is the value of statistical life (VSL), indicator used in American insurance statistics;
- using accounting values and the scope of incurred losses, popular in accounting of enterprises and households;
- and using methodologically unclear estimates of cash-indexed losses.

There are also snapshots showing the effects of disasters, for example psychological or social, without estimating their economic value (Kanisty, 2003). Therefore, it is not possible to introduce them into the economic account, without preparing appropriate valuation techniques and methods.

An even more dominant group are studies based on mathematical models to assess the risk of natural disasters (for example, global climate change) and its effects on the economy and society (Stern & Stiglitz, 2022). Sub-analyses on, for example, floods (Kuźmiński, 2018) or cultural heritage assets are interesting but do not connect to the possibilities of assessing or estimating the losses of natural disasters. However, they are not useful for constructing a system of cost accounting for natural disasters.

A significant number of studies focus on the evaluation of existing solutions for financing and organizing emergency management and disaster recovery at different levels, from local to national (Galinski, 2018). There is no proposal to unify methods and techniques for estimating losses and costs of natural disasters (Ficoń, 2019).

However, there are fewer methodological studies on the precise identification of losses, costs and avoided costs (and therefore benefits) of natural

disasters, catastrophes and long-term negative impacts (for example, ecological, health or social). An interesting exception might be the World Bank study “Investment in Disaster Risk Management in Europe Makes Economic Sense,” 2021. It looked at the costs and benefits of preventing natural disasters in Europe. The study weighed the benefits of disaster prevention and/or mitigation against the costs of necessary investments. The analysis covered more than one hundred investment projects. Four groups of benefits were identified: (1) reduction of human casualties, (2) avoidance of quantifiable losses, (3) stimulation of the economy by preventive investments, and (4) derived benefits in the economy. Based on these, the benefit-cost ratio (BCR) of the profitability of preventive investment was developed. In a similar direction are considerations of Nicholas Stern in the work “Global deal” (Stern, 2010), where the issue of rationalization of disaster risk estimation is exposed.

Another good starting point for developing attitudes for loss identification and disaster cost accounting systems can be the Stern Report (*The Economics...*, 2007). It contains several important conclusions, such as:

- “there is still time to avoid the worst impacts of climate change, if we take strong action now,
- climate change could have very serious impacts on growth and development,
- the costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly,
- action on climate change is required across all countries, and it need not cap the aspirations for growth of rich or poor countries,
- a range of options exists to cut emissions; strong, deliberate policy action is required to motivate their take-up, and
- climate change demands an international response, based on a shared understanding of long-term goals and agreement on frameworks for action.” (*The Economics...*, 2007).

However, their verification and implementation requires the construction of a global loss and cost accounting system for natural disasters.

Some researchers adopt a different perspective, treating disasters as a factor stimulating the economy. This allows to justify the Keynesian argument of economic stimulation and socio-economic development. In this case, the existence of a unified system for recording losses and costs of natural disasters and catastrophes is also essential.

However, in the literature that we are aware of, there is no call for building a globally unified system for recording losses and costs of natural disasters and catastrophes. The lack of adequate conditions to undertake such work does not exempt us from reporting such a need. This challenge is much more important than building more models for such phenomena with limited cognitive and implementation values.

Methodological remarks regarding the desired calculation of costs on a global scale

Before we propose the elements of a methodology for studying the costs of contemporary environmental barriers and developmental threats, it may be appropriate to look at the concepts of threat and crisis. The idea of threat includes foremost the possibility of occurrence with a certain level of probability (risk) of a given negative, usually fairly homogeneous phenomenon. A threat is “a situation signalling something that may occur, usually something bad, undesirable, or dangerous” (Markowski, 2004). The potentiality of realisation (occurrence, coming into existence), as well as one-dimensionality of effect, are characteristics of threats. A crisis is a co-mingling of many threats that transform potential into an actual situation. It signifies the occurrence of different negative phenomena with all of their consequences. Therefore, while the costs of threats are potential quantities, which means methodologically they have to be weighed as risk levels, or probabilities of their occurrence, then under crisis circumstances, these costs become real quantities. If they are costs, then their assessment (evaluation) was performed using accepted and approved evaluation or accountancy techniques (Roubini & Mihm, 2011).

The present paper draws attention to the different kinds of costs which occur in a process-based (cybernetic) approach to crises and threats. Here we can propose the following chronological schema of costs of the occurrence and development of crises (threats) for contemporary civilisation (Figure 1). It encompasses the entire process of emergence and liquidation of consequences linked to a given crisis (threat), including:

- the initial stage of the crisis (threat) emerges as a consequence of human actions, which are its primary causes,
- it transitions into the stage of development of crisis phenomena, following different paths of development of changes, from the proportional and linear, easy to model, through the linearised (able to be presented as linear), to the non-linear, most often encountered in reality, all of which at some level allow for assessing the negative consequences,
- next, it transitions to the stage of preparation and realization of anti-crisis policy, which may be limited to containing the negative consequences to an acceptable level or may lead to their complete liquidation and prevention of the future occurrences of this type of crisis.

Each stage is the source of particular costs which are borne by persons, social groups or entities subject to the negative consequences of a given crisis (or threat). Although costs are the subject of the present analysis, we must remember that the co-mingling of phenomena related to a given crisis may

include benefits intercepted by some entities, not necessarily internalized by their appropriate recipients. Some entities bear costs, others block benefits to which they are not entitled. In the macroeconomic or mega economic (global) calculus, the internalisation of costs and benefits is a secondary consideration. Much more important is the issue of the positive or negative sign and the quantity outcome of the economic calculus (benefits minus costs). This is what determines whether we are talking about a crisis (when the sign is negative), and what are its proportions (size of the outcome of the calculus). Internalisation is mostly an issue of intrageneration and intergeneration justice and ethical integrity (Mączyńska, 2017).

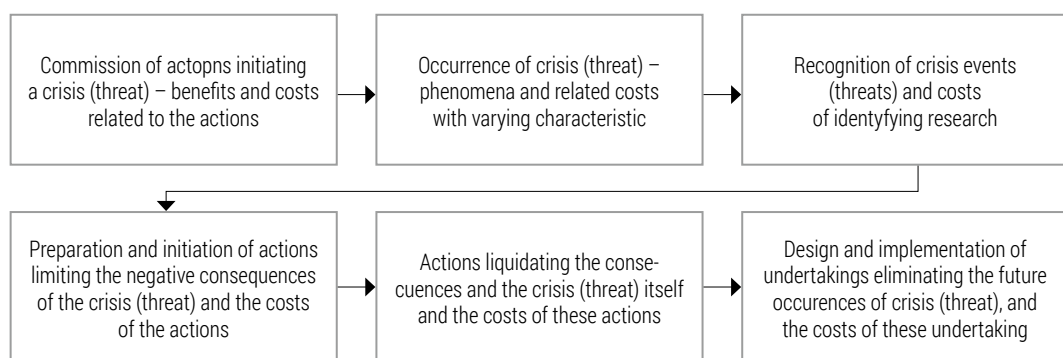


Figure 1. Chronology of the occurrence and development of crises (threats) of contemporary global civilisation and related costs

Source: author's work.

Taking into account the wide range of the presented issues and the limited scope of the present paper, the authors focused on several remarks regarding the methodology of research and the identification of the dimensions of contemporary global crises of human civilisation. To avoid oversimplification, even a short review of the literature was omitted, as it would have to include the very rich literature on cost calculation, as well as the even more voluminous sources of information regarding the contemporary crises of human civilisation. The authors hope that this paper will become an impulse or encouragement for scientific discussion and future research. However, such research is a task for large teams and large research projects. The authors, as economists, are cognizant of another challenge, which they do not take up in the present paper, namely: are contemporary economic sciences up to the tasks (challenges) posed by civilisation in the XXI century. This is a question for other studies (Kirman, 2018).

As mentioned, the purpose of the present paper is an attempt to identify the characteristics and varieties of costs which appear at each stage of the

recognition of a crisis (threat) of a given kind. The following questions, therefore, become important:

- 1) how important are costs in the economic calculation, versus benefits, versus the outcome of their comparison (profit or loss, economically speaking);
- 2) what are the characteristics of the varieties of costs, or how potential versus how real are the costs; in the first case, the probability of their occurrence becomes an important issue, in the second case, the way of evaluation becomes an issue;
- 3) if they are the costs of fighting the undesirable effects of a crisis (threat), which are reactive, or if they are costs of fighting barriers, which are preventative;
- 4) what are the quantities of the kinds of the studied costs, that is, what are the relations between the size of the crisis (threat) and the size of the costs;
- 5) what kinds of costs occur in each stage of the emergence and development of crises (threats) of contemporary civilisation;
- 6) what are the concrete forms of costs related to the specific main crises (threats) of contemporary civilization.

The answer to the first challenge is extremely important not only from a cognitive, but also from an accountancy point of view. From a cognitive perspective, studying costs shows that practically any event, as a rule, generates costs and benefits, which means that even such situations as crises have two dimensions related to their positive and negative consequences. If that is indeed so, then while studying their widely understood consequences, we must consider the outcome of comparison between evaluated costs and benefits. Additionally, if a given phenomenon displays higher benefits than costs, it cannot be called a crisis or threat.

The second challenge presents two important and difficult cognitive and accounting problems. The first is related to the potentiality of costs, which then take on the attributes of risk. In particular, we must know the probabilities of their occurrence, which may be expressed as weights of expected value, according to the Pascal or Bernoulli theorems. The more precise the weight is, which depends on the assessment of the probability distributions of risk, the more precise the calculation of costs will be. The second problem is related in particular to consequences that do not have a market price (value), which is highly valued in economic accountant circles. However, we must remember that many adverse effects of crises are not reflected in the market, which forces the development of appropriate methods of evaluating them (Becla, Czaja, & Zielińska, 2012). This may be considered one of the more critical challenges of contemporary economics, especially the economic theory of value, accountancy, or cost calculus.

The third challenge mentioned is mostly related to decision-making and management and is partly associated with the strategy and policy of reacting to barriers to development. If such strategy and related policy concentrate on reacting to the negative consequences of a crisis (threat), then the scope and varieties of incurred costs will be different than in the case of a preventative approach meant to anticipate potential threats. There are ongoing disagreements among economists studying the calculation of costs, as to which approach incurs higher costs in economic resources. The most probable position is that neither of these views is unequivocally dominant, meaning that in particular circumstances, one approach is more costly, while in other circumstances, the other is more costly. The preventative approach perhaps requires more knowledge and skill. However, the reactive approach may cause the occurrence of consequences that are irreversible or very hard to reverse. Then the costs of their liquidation rapidly grow even to infinity, and economic calculation loses its purpose and utility.

The fourth challenge is very interesting from the accounting point of view, as it is connected to the quantitative relations between the size of the crisis (threat) and the size of the costs related to it. In cost calculations, it is most often assumed, and this assumption seems justified, that most relations are directly proportional (linear) or linearised – the bigger or deeper the phenomenon, the bigger are the costs related to it, in appropriate proportions. There are situations, however, where the relations become non-linear. This may be as a result of synergy, which means additional influences (scale effects or critical mass effects) that are difficult or impossible to predict, or a result of many-directional influences on the size of the costs of different factors. The recognition of these relations forms the basis of introducing and utilising the appropriate accounting formulae in the calculation of costs.

The fifth challenge is a very curious issue. What are the kinds of costs that we encounter when evaluating the various forms of crises (threats), and what are the kinds proposed to us in this area by the theory of economic costs? Numerous studies related to social and economic costs show a wide variety of their kinds, as well as still existing shortcomings (Becla, 2019). The following costs, among others, were distinguished in that paper: (1) accounting costs, (2) transactional and quasi-transactional costs, (3) alternative costs of lost possibilities, (4) external costs to other entities, (5) various non-internalized social costs, (6) costs of purchasing data and information and/or data collection services, (7) costs of violating the law by the entity collecting data and information, (8) social costs of the diffusion system that cannot be internalised. It is most often postulated to consider the following four groups of kinds of costs in complex situations of crisis (threat): (1) accounting costs, *explicite*, (2) alternative costs, which together with the first group are the economic costs, as well as (3) transactional costs, and (4)

widely understood social costs, together with external costs. Detailed analyses of given socioeconomic situations often point to additional challenges, when particular costs generate kinds of costs that are difficult to define.

The last, sixth challenge stated is related to issues of identifying, quantifying and evaluating, which come in real and potential form, as well as *ex post*, *in tempora*, or *ex-ante*, with every given crisis (threat) of contemporary civilization on a global scale. Examples of such combination of threats are the following: (1) environmental-climate crisis, demographic crisis, economic-financial crisis, virtual computer network and information network crisis, crisis of democracy and political institutions, and (2) economic threats, health threats, ignorance threats.

The desired calculus of costs proposed by the authors poses many cognitive, methodological and accounting challenges in four significant dimensions:

- spatial, spanning from the local to global scale,
- temporal, including research on the past, present, and future,
- variety of costs, related to the diversity of considered costs,
- variety of problems, related to the wide scope of considered forms of crises (threats).

Keeping in mind the complexity of the mentioned area, a few remarks are made about the chosen dimensions of contemporary global crises of human civilisation. The authors have chosen the examples. The choice includes elements considered most important by the authors, posing the largest threat to the future development of human civilisation on a global scale. Because the authors are adherents to the Sagan-Building idea of “spaceship Earth”, the global perspective is the only appropriate one in their view. Although global phenomena are analysed, one must keep in mind that many threats are generated as microeconomic processes by the proper formation of attitudes and behaviour of micro-entities, often singular actions or micro trends. (Penn, Kinney, & Zalesne, 2009) Next, as they become widespread (occur more often) and deepened, they become global problems (Czaja & Becla, 2007).

Basic groups of costs generated by the global climate crisis (“black swan”)

It is good to take a brief look at the main groups of costs generated by the global crises (threats) of the human civilisation distinguished above.

Global climate change and other environmental problems on this scale affect the entire globe. Apart from climate change, such global problems include: (1) degradation of the ozone layer, (2) deforestation of the Earth’s surface, (3) desertification of the planet, (4) pollution of seas and oceans,

(5) degradation of drinking water reserves, (6) degradation of biodiversity, (7) degradation of natural landscapes, ecosystems, and non-economic utilities of the natural environment, as well as (8) acid rain, and (9) outer space pollution (Czaja & Becla, 2007).

Therefore their scale and complexity generates the most groups of costs. Practical research of this type would be extremely difficult to conduct on a global scale. Case studies of local ecosystems or particular types of effects seem to be a better solution in terms of practical realization. These types of approaches may minimise estimation and calculation errors.

Several extraordinarily complex methodological and accounting problems emerge about all estimations on a global scale; these include:

- extremely hard to identify negative (mostly cost-generating) and positive (mostly benefit-generating) outcomes of the given crisis (threat);
- the fact that most outcomes are nonmarket-related, which calls for the development of appropriate but uniform methods for their evaluation;
- the need to determine the entities that are the primary agents and the recipients of certain costs, which are often external.

Taking into account the current level of recognition of problems, the current climate environmental crisis generates and will continue to generate (Kośmicki, 2009):

- direct costs of the degradation of the natural environment on vast areas of the planet, identified in numerous detailed empirical studies;
- ongoing costs of current actions limiting the most dangerous negative environmental consequences;
- the costs of increased disease prevalence and mortality due to environmental reasons;
- the benefits and environmental services lost due to deforestation;
- the costs of loss of soils suitable for agriculture and animal breeding due to desertification;
- economic losses (e.g. to fishing or tourism) due to pollution of the sea and oceanic waters;
- economic and non-economic consequences of diminished availability of drinking water;
- loss of benefits due to the degradation of biodiversity, natural landscapes or environmental services or utilities; these lost utilities may include: (1) loss of undiscovered species (loss of biological knowledge), (2) loss of production and nutritional value of unused animal and plant species, (3) losses due to danger to crops and livestock from new diseases and parasites, (4) loss of new drugs and substances for the pharmaceutical industry, (5) loss of new substances and materials usable by industry, (6) depreciation of human ethical and moral systems, (7) loss of aesthetic value, (8) loss of potential information about various environmental pro-

- cesses, (9) threat to life on Earth, and (10) threat to the existence of human civilisation, especially to future generations (Czaja & Becla, 2007);
- the costs of maintenance of material infrastructure and historical monuments, as well as soils and surface waters as a consequence of acid rain;
 - the costs of threats to devices placed in outer space (telecommunication satellites, telescopes and research equipment) and danger to human life (astronauts).

These are several chosen kinds of costs related to the climate-environmental crisis (Klein, 2016; Popkiewicz, Kardaś, & Malinowski, 2018; Czaja, 1998). Each of the above groups of costs may be analysed into particular costs: accounting, alternative, transactional, and external, including social, each referring to a form of unfavourable influence on the natural environment. Each of the above groups of costs requires the following procedure for recording: (1) detailed identification of particular components, (2) quantification of their size in natural units and (3) monetary valuation that allow for comparison and aggregation of these costs.

Identification requires appropriate knowledge of the effects of environmental threats and crises, understood as their costs. It also requires a detailed specification of their kinds if they are meant to be an accounting/recording macrosystem element. Quantification should be based on sufficiently (acceptably) precise size measurements in natural units of their occurrence. Monetary valuation generates two groups of challenges: (1) finding market (meaning priced) counterparts for adverse outcomes of threats/crises or (2), if such images do not exist, developing acceptable methods of evaluating negative consequences.

The remaining forms of global environmental problems such as (1) destruction of the ozone layer, (2) deforestation of the surface of the Earth, (3) desertification of the surface of the planet, (4) pollution of seas and oceans, (5) degradation of drinking water reserves, (6) degradation of biodiversity, and (7) degradation of natural landscapes, ecosystems, and non-economic utilities of the natural environment, as well as (8) acid rain, and (9) outer space pollution, generate similar groups of costs, which require identification, quantification, and valuation. A similar approach may be applied more widely, to other kinds of threats to contemporary human civilization, for example: (1) the demographic crisis, which means global overpopulation, especially in the countries of the impoverished South, and global migration movements; (2) the economic and financial crisis, which is related to uncontrolled actions of Veblen's "business world" on a global scale, widespread debt on all levels, from households to states, as well as poverty in many forms, and property and income polarization, (3) economic threats in the form of excessive consumerism and aggressive marketing, with various consequences, (4) health threats, which not only result in lowered lifespans,

changed death rates (with prevalent deaths related to cancer, respiratory system diseases, circulatory system diseases, and obesity), disease-to-pharmacological-treatment chains, and new threats, and more frequent epidemics (malaria, AIDS), or even pandemics (coronavirus), (5) ignorance and irrationality, a peculiar phenomenon in a world with dynamic science growth, (6) a crisis of information and computer networks, of the Internet and virtualization, with all its negative consequences with short-term and long-term consequences, (7) crisis of democracy and democratic and political structures, leading to totalitarian states, and populist attitudes and actions, as well as (8) civilization, cultural and religious conflicts related to a lack of tolerance in particular axiological systems.

Raising the topic of the sources of the costs of the crises of human civilisation on a global scale, the authors were cognizant of their cognitive, methodological and accounting complexity. They were not entirely convinced that this type of problem could be solved on this kind of scale. Global accounting would be possible under two essential conditions: (1) everyone should want the realisation of this kind of idea, and (2) a global system of recording such costs should be developed, modelled after the *System of National Accounts* (SNA). These conditions are not easily fulfilled, which is confirmed by the following: the increasing ignorance and irrationality and the difficulties with global socioeconomic statistics, despite the seventy years it has existed for. In many (indeed most) states, an SNA system does not exist. All attempts at introducing new measures and indicators, such as HDI, sustainable growth indicators, or KAM for an information society, do not find an appropriate reference and are based more on external estimations than on precise record-keeping, which weakens their significance.

The question of the viability of the development of a calculation of the global costs of the crises of human civilisation is related to a different one – what is the purpose of making such calculations? An affirmative answer is connected to several points:

- for cognitive reasons, which do not need to be justified, and which positively affect the development of science, including economics and economics of waste,
- due to the desire to realise joint ventures (global policies),
- for consciousness reasons, in order to convince the necessary part of humanity to initiate preventative measures,
- to strengthen international cooperation and development of global governance,
- to limit waste in all forms of human activity due to the growing scarcity of resources and anthropopression on a global scale.

This is an opportune place to raise two other reasons for which global accounting makes sense:

- the s-logistic or non-linear characteristic of the development (evolution) of many phenomena and processes,
- the problem of information overload, or the overabundance of information about the human brain's capacity for absorption.

Regarding the non-linear trajectory of the evolution of phenomena (processes), the problem of the difficulty of their prediction is generated and the issue of reacting to their negative consequences. Contemporary economics has few methods helpful in this domain. Their development is one of the modern economic theory's most challenging and critical cognitive challenges. The overabundance of information poses a different danger related to the fact that it is necessary to utilise algorithms or, indeed, to subordinate humans to algorithms and computer programs.

Does the development of economic sciences and systems of accounting and compilation of data (information) allow for an effective solution for the above challenges? The answer to this question is affirmative. If it was possible to develop and introduce a global system of accounting for the costs of crises (threats), there would be a chance for: (1) limiting their scope and range through better prediction and more effective reaction, (2) strengthening international cooperation, and thus in its scope a more just internalisation of such negative effects, (3) taking more effective (efficient) preventative measures. It bears remembering that the mentioned and other global forms of threats and crises will only intensify and not desist. Perhaps such a global system of accounting the costs of problems (threats) is one of the significant fail-safes necessary for the survival of human civilisation in the coming decades.

Conclusions

The growing number, variety, and depth of threats and crises of contemporary human civilisation prompts the following conclusion: it is necessary to develop macrosystems for accounting for the negative effects of such phenomena, understood in categories of cost calculus. This demands fulfilling a few preconditions, most importantly: (1) deepening the development of research on threats, crises, or civilisational barriers, (2) developing the methodological accounting basis for such macrosystems, modelled after SNA or LINK, and also (3) the presence of political will for the development of such global system of accounting the costs of negative phenomena. The existing legacy of international agendas, government institutions, NGOs, research institutes, academic centres, insurance companies, or national and international systems for socioeconomic statistics may be utilised. The need for the existence of such a system is beyond discussion in light of humanity's experiences.

The contribution of the authors

The article was written in collaboration by all authors.

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