THE IMPACT OF EXTREME RISK EVENTS ON THE ECONOMY

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Abstract
In this paper I wanted to highlight the impact of extreme risk events on the economy. The issue that I will approach in this paper is one of great importance, taking into account that extreme risk events that occur are different and are becoming more frequent and harder to control. The quickly development of these eventsrequires the implementation of a suitable risk management system. The complexity of this issue involves different approaches that can be interrelated in: computer science, mathematics, risk management, crisis management, andmodeling and simulation of extreme risk events. Natural disasters are rare events, but when they occur are causing a huge damage and an adequate management is necessary to return to a state of normality in a short time. To achieve our goal, in the first part of the paper, we presented the problems that an extreme risk event causes in a country when they occur. In the last part of the paper I presented analytical, statistical and econometric methods used in analysis of the impact on the economy of extreme risk events.

Natural disasters, which are extreme risk events, rarely produce, but when they occur causing hugedamage and an adequate management is necessary to return to a state of normality in a short time.

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I. INTRODUCTION

Extreme risk events are part of our life, and people, by the decisions and actions they make they can prevent their occurrence.

Some extreme risk events (eg natural disasters) do not depend on people, who can control or manage in a little degree these events.

People know that their environment is not secure, no matter how hard one may try this.

Knowledge is important for everyone. We must know our environment in order to intervene at any stage of an extreme risk event , to stop or to reduce the negative effects.

Although the goals and objectives of a human in case of extreme risk events are different, the principles of intervention are the same (speed, flexibility, adaptability, protection of the population etc.).

II. EXTREME RISK EVENTS

In the ONU report from 2004 we find definitions of risk, hazard and disaster. So, the hazard is a potentially destructive physical event, phenomenon or human activity that may cause loss of life or injury, property damage, subverting the economy or environmental degradation. Hazards are characterized by location, intensity, frequency and probability.

The disaster is a massive disruption of the functioning of a community and society, causing human, material, economic or ecological scale beyond the capacity of the affected community or society to counteract them with its own resources.

The risk is the probability of producing harmful consequences or expected losses (deaths, injuries, destruction of property, economy and environment) due to interactions between natural or human hazards and vulnerable conditions.

The risks main characteristic can be defined by uncertainty and danger, vulnerability and value (Sorocovschi, 2002).

The danger is the probability that an extreme event of certain intensity to affect a particular area in a period of time (the event can be flood, drought, pollution, etc.).

Vulnerability refers to the attitude of a certain segment (population, economy, natural resources, infrastructure) to support the effects on the intensity of the phenomenon. Vulnerability can be expressed as the ratio between the intensity of the event and the damage caused.

Exposed value or exposure refers to the element that must support the event (can be expressed as the number of people, the value of a property, production capacity, natural resources, etc.).

The extreme risk event is causing a total risk (value expressed casualties, of the wounded, the damage of economic activity and property), expressed in terms of annual cost, quantity or lost units per year.

Risks can be (IGSU):

- Destructive natural phenomena of geological origin or meteorological or illness of a large number of people and animals, suddenly produced, as mass phenomenon. This category includes earthquakes, landslides and land collapses, floods and extreme weather events, epidemics and epizootic diseases;
- Events with serious consequences on the environment caused by accidents. This category includes: chemical accidents, biological, nuclear, underground, damage hydraulic structures or pipelines, mass fire and explosions, major accidents to machinery and dangerous technological installations, falls of cosmic objects, major accidents and breakdowns of networks installations and telecommunications.

Risks can be defined by the terms of vulnerability (urbanization, environmental degradation, lack of education, population growth, economic fragility, poverty, bureaucratic emergency structures etc.) and hazard (or extremely rare event of natural or human nature, affecting life, property and human activity, whose expansion lead to disaster).

In order to counter risks we should focus on three elements: prediction, prevention and their mitigation.

The forecast covers all the activities dedicated to the study and determine the causes of extreme risk event, risk identification and individualization of the parties expoused to risk. This is almost always expressed in terms of probability. The forecast also imposes an extreme risk event monitoring.

Prevention refers to activities necessary to avoid or minimize the consequences of extreme risk event. This item is interrelation with risk prediction because once established (and made risk maps, which is a basic tool in the decision making process) can move on adoption of interventions to mitigate it.

Through programs for prevention of extreme risk event is intended to eliminate or reduce the intensity and consequences of extreme risk on the elements submitted to risk, in a certain period of time and on a particular area.

For situations in which extreme risk events occur intensive it is used emergency plans (containing operative intervention procedures).

The risks can be assessed by following the steps of risk identification, analysis and vulnerability assessment. This evaluation aims to achieve measurable standards by which the risk can be compared to other similar estimate.

Identifying risk is to reduce or avoid possible losses generated by various risks, the achievement of rebuilding economic and social in a short time, achievement of prevention and preparation for intervention and implementing measures to further intervention for recovery and rehabilitation.

The risk can be expressed mathematically as the product of hazard (H), elements of risk (R) and vulnerability (V):

$$R = H x R x V$$

Using this formula can be made calculations to assess the damage caused by natural or technological various phenomena.

Risk is a probable status of a system defined by the potential shown with a magnitude exceeding a threshold generally agreed, with the estimated recurrence intervals in time and space that cannot be exactly determined (IGSU).

Risk can be defined as the product of probability and loss. Most extreme risk event have strong impact, so it is necessary to consider the evaluation of the consequences.

Extreme risk events require a system of risk management for extreme risk events, which is a way to improve and increase the efficiency of interventions in these cases.

In the everyday life there are series of core indicators in preparing weather forecasts, of extreme risk events (eg environmental pollution), and indicators that can be used in the phase of monitoring and analysis to know in detail the events.

In the table below we present the types of indicators to assess extreme risk event and their description.

Table 1. Typologies of indicators to assess extreme risk event

Nr. crt.	Evaluation Indicators	Description
		Status indicators
1.	Presence	Sources of data and information, sensor systems, databases and monitoring teams provide data on the presence of signs of possible extreme risk event, on those in progress and on the effects on the passed one.
2.	Consistence	The team's analysis and monitoring are carrying out analysis and assessments regarding consistency indicators and any indication that help the location of an event on a scale of danger and threat to their absence, to the highest degree (maximum danger, imminent threatened, very severe etc.) and the degree of risk involved, assumed or imposed, from the lack of risk at extreme risk.
3.	Previous	Analysis and assessment teams analyze all previous (earthquakes, torrential rains, floods, natural disasters, nuclear accidents, technological accidents, environmental accidents, etc.) and develop statistical documents and conclusions resulting from it.
4.	Structure	Systems analysis and evaluation are considering the indicators concerning the pattern of events that generate emergency and those of emergency (indicators of alert of the event, indicators concerning the nature of the event, eg: torrential rain with thunder and strong winds, tornadoes).
5.	Progress	Here are taken into account indicators during the performance of its on the the coverage, scale, intensity, strength, duration, etc.
6.	Interconditionality	Here are taken into account connection indicators (eg, the combination of heavy rains and floods of industrial accidents and environmental pollution etc.).
		Dynamic indicators
1.	Interaction	Are identified and analyzed indicators that provide data regarding interactions between components of the event during its evolution.
2.	Development	Variability, intensity, size, power, dynamics event.
3.	Evaluation	Evaluation scale (eg Richter scale, Mercalli scale, in case of earthquakes, depth etc.).
4.	Transformation	Indicators of transition from one status to another of the event (eg converting a storm into a tornado).
5.	Forecast	Are taken into consideration the indicators that generate a vision of an event, future course of an event, evolution, transformation or increase it.
		Indicators of finality
1.	Results	Indicators on the report of the main event of extreme risk parameters, quality of intervention and the results of the intervention.
2.	Effects	Here are taken into account effects chains (planned, expected, produced, but also collateral, unwanted, accidental, chained), database can be used to analyze the effects on their comparative etc.).

Source: http://iss.ucdc.ro/studii-pdf/Management%20urgente.pdf, accesed at 10 september 2015.

III. THE IMPACT OF THE EXTREME RISK EVENTS ON THE ECONOMY

The negative effects of extreme risk events can be expressed in terms of impact on population, psychological, social, economic or environmental.

In 2014, the world held more than 200 significant natural disasters that have resulted in the loss of more than 50,000 people. Economic losses caused by natural disasters were approximately 99.2 billion dollars, much lower than the economic losses caused by these extreme risk events in 2013 (147 billion dollars). In the following table we can see examples of extreme risk events and the impact that these events had had on the economy.

Table 2. Examples of extreme risk events with major economic losses in 2014 – 2015

Date	Country	Extreme Risk Event	Victims	GDP	Economic losses	Economic losses % of GDP
May 2014	Sierra Leone	Febra hemoragică Ebola	2655 persons	4,89 billions dollars	4 billions dollars	30%
March 2014	Liberia	Febra hemoragică Ebola	3384 persons	2,02 billions dollars		
December 2013	Guinea	Febra hemoragică Ebola	1654 persons	6,62 billions dollars		
July 2014	**China**	Taifun	56 persons	10.360 billions dollars	4,32 billions dollars	0,04%
May 2014	**Bosnia**	Inundații	44 persons	18,34 billions dollars	1,47 billions dollars	8%
May 2014	**Serbia**	Inundații		43,87 billions dollars	3,39 billions dollars	8%
April - May 2015	**Nepal**	Cutremure	8000 persons	19,64 billions dollars	10 billions dollars	50%

The economic impact of the extreme risk events quantify all economic damages generated by this event.

Criteria representing all material and economic damage (economic loss) consists of the inventory value of goods, infrastructure, property, crop materials including environmental elements that can be quantified in monetary value, stocks affected by the event, restoration costs, the value of lost production to recovery and costs of the intervention. It is expressed in the above table as a dollar amount and percentage of GDP.

IV. METHODS AND MODELS USED IN THE ANALYSIS OF EXTREME RISK EVENTS

In order to analyse the risks and make forecasts of the economic indicators we can use the following methods and models:

1. The expected value analysis method (VA) – it is the simplest method of risk measurement and it is calculated as the product of the probabilities (P) of occurrence of events and their effects (E):

$$VA = P \times E$$

We should take into account in this analysis that tan estimate of probabilities involves a high degree of subjectivity. By this method yields results which are used as input for further analysis.

2. Probabilistic analysis – refer to risk analysis, control possibilities and effect on control measures regarding consequences, the probability of occurrence and estimating the level of risk.

3. Simulations – use models of systems to analyze their performance and behavior and represents an advanced risk measurement method. This technique simulates the objectives of a large number of times, providing a statistical distribution of results.

Monte Carlo analysis - was developed in 1940 and is a computerized method that uses statistical sampling techniques to obtain a probabilistic approximation to the solution of a model. The simulation consists in approximation of the result of a random repetitive pattern by applying the algorithm model.

Monte Carlo Simulation combines probability distributions in accordance with the existing relations models, by trying several combinations of input variables and storage of results for display. The relevance of this method is that the results are often graphs of probability distributions or cumulative probability distribution of output variables such as total cost or completion dates. These results allow the comprehensive and objective measurement of various risks.

4. Decision trees analysis

Decision trees are key instruments that describe interactions between decision and random events, as perceived by decision makers. Tree branches represent the decisions or random or uncertain results (Scradeanu, 2014).

• Expected Value (VA) of an effect = Effect x The probability of effect.

• The expected value of a decision = The amount of the expected values of all effects resulting from that decision.

Decision trees have the advantage of achieving a graphical representation of the chronology of events and alternatives.

The tree represents either decisions (shown as squares) or random or uncertain results (shown as circles).

5. PERT analysis – it is generally used for programming schedules, based on the values an the probability of durations required to perform the tasks of a project. Since the durations of tasks project may be a range of values, it is possible that the actual duration values to determine a critical direction different from the early criticism, from the most probable values.

6. Multiple linear regression model

Economic process development depends in most cases on many factors, some of them very important, and some of the minor importance, accidental acting (Pecican, 2000, p. 50). In such cases, we recommend multiple regression (Multiple regression was used in the study of economic processes for the first time by the Italian statistician Benin in 1907). Multiple linear regression contains a dependent variable and more independent variables, which can be a linear connection and non-linear one.

The shape of a multiple linear regression model with two independent variables and a dependent variable is:

$$Y_{X_1X_2} = \alpha X_1 + \beta_1 X_2 + \varepsilon \quad (1)$$

where:

- Y is the dependent variable;
- X_1, X_2 are independent variable;
- ε is the random error variable (residue);
- α , β_1, are ratios or regression parameters.

Modelling a multiple linear regression model is achieved in the following assumptions: normality errors, mismatch errors, the mismatch between independent variables and variable error; lack of colinearity or of a linear connections between independent variables (Macovei, 2012, p. 66).

The parameters of the regression model provides information on changing the dependent variable. In practice, for the determination of the parameters are considered the data of a level of *n* volume. In these circumstances the multiple linear regression model $Y=\alpha X_1+\beta_1 X_2+\varepsilon$ se causes regression model parameter estimation.

Being the equation estimated of multiple linear regression model (Macovei, 2012, p. 67):

$$\hat{Y}_{X_1X_2} = \hat{\alpha}\, X_1 + \hat{\beta}_1 X_2 \quad (2)$$

where:

- $Y = (y_1, y_2, ..., y_n)$;
- $X_1 = (x_{11}, x_{12}, ..., x_{1n})$;
- $X_2 = (x_{21}, x_{22}, ..., x_{2n})$;
- $\varepsilon = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_n)$.

then for a sample volume *n*, we have

$$\hat{y}_i = \hat{\alpha}\, x_{1i} + \hat{\beta}_1\, x_{2i}\ ,\ i = \overline{1,n}. \quad (3)$$

For multiple linear regression model with two independent variables, point estimates can be determined using least squares, solving the system:

$$\begin{cases} n\hat{\alpha}\sum_i x_{1i} + \hat{\beta}_1 \sum_i x_{2i} = \sum_i y_i \\ \hat{\alpha}\sum_i x_{1i}^2 + \hat{\beta}_1 \sum_i x_{1i}x_{2i} = \sum_i x_{1i}y_i \\ \hat{\alpha}\sum_i x_{1i}x_{2i} + \hat{\beta}_1 \sum_i x_{2i}^2 = \sum_i x_{2i}y_i \end{cases} \quad (4)$$

In such analysis we can apply Kolmogorov-Smirnov test which is a recommended test for ordinal variables, When normal distribution hypothesis is not plausible or when the variables are numerical, but the samples are small and distribution information are absent.

V. CONCLUSION

In case of occurrence of extreme risk event each organization must have its action plan to mitigate their effects or prevent detrimental effects.

Risks can be analyzed using qualitative and quantitative methods. First, is required a qualitative risk analysis, that helps us to prioritize them, after they are identified. After this step we should use a quantitative analysis, so major risks will be included in the risk model.

Decision analysis through models and simulation cannot have effects on the hazard, but it can help policy makers in making decisions and increase your chances of getting good results and to deal with the negative effects that may occur.

Nowadays it is used more and more simulation in various fields, and this is encouraged by the increasing number of software simulation (continuous development of this area), the large amount of existing data and information, prices situated at acceptable levels, existence of some packages that allow simulation in specific areas etc.

Although, initially, the simulation was used only when it was not possible to apply an analytical model, with the developments in computing these models have gained ground and became commonly used instruments in making decisions.

Policy makers need to be aware the simulation provides information and data that can help them in making decisions and not make decisions for them.

In order to be accepted in the decision-making process a model should be verified before implementation.

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