Una aproximación Europea a la valoración económica de las catástrofes

A European approach to the economic valuation of catastrophes

Ana FERNÁNDEZ-ARDAVÍN MARTÍNEZ
Prof. Contratada Doctora
Universidad Rey Juan Carlos, Madrid

Isabel MARTÍNEZ TORRE-ENCISO
Prof. Titular de Finanzas de Empresa
Universidad Autónoma de Madrid, Madrid

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RESUMEN:

El proceso para obtener una valoración económica de las consecuencias de una catástrofe está generalmente dividido en dos fases: post y pre-desastre. Mientras que la valoración económica tradicional se centra en valorar los daños posteriores al desastre, las medidas de mitigación y preparación deben ser tenidas en cuenta como una reducción del coste de desastre. La valoración tradicional se lleva a cabo durante la fase de respuesta. Sin embargo, no es fácil obtener la información necesaria para evaluar la magnitud de los daños directos, menos aún los efectos indirectos y secundarios.

El objetivo de este documento es marcar directrices y establecer elementos básicos que permitan comenzar los pasos para establecer una metodología integral y uniforme que permita evaluar los efectos económicos de los desastres como una herramienta para la toma de decisiones, el establecimiento de rehabilitación, recuperación y reconstrucción, así como la necesidad de crear planes y programas. Este trabajo es en sí mismo, un breve resumen de la presentación realizada en la reunión de constitución del Proyecto Mayor Europeo[1] (EU PROJECT: SUB / 00 / 287037)

Palabras Clave: Valoración económica, Gerencia de riesgos, Proyectos multidisciplinares.

ABSTRACT:

The process to obtain a catastrophe economic valuation is usually divided into pre-disaster and post-disaster phases. While the traditional catastrophe valuation is focused on post-disaster effects, the preparedness and mitigation measures must be necessarily accounted as a catastrophe cost, or more specifically as a reduction in the post disaster cost. The traditional valuation is carried out during the emergency phase. However, it will not be easy to obtain the information needed to evaluate the magnitude of the direct damage, still less the indirect and secondary effects.

The aim of this paper is to bring some guidelines to prepare a comprehensive and uniform methodology for evaluating the socio-economic effects of disasters as a tool for the adoption of decisions on the direction and priorities of rehabilitation, recovery and reconstruction plans and programs. It is also a brief summary of an initial meeting of a European Union Research Project[2] (EU PROJECT: SUB / 00 / 287037)

Keywords: Economic Valuation, Risk Management, Multidisciplinary Projects.

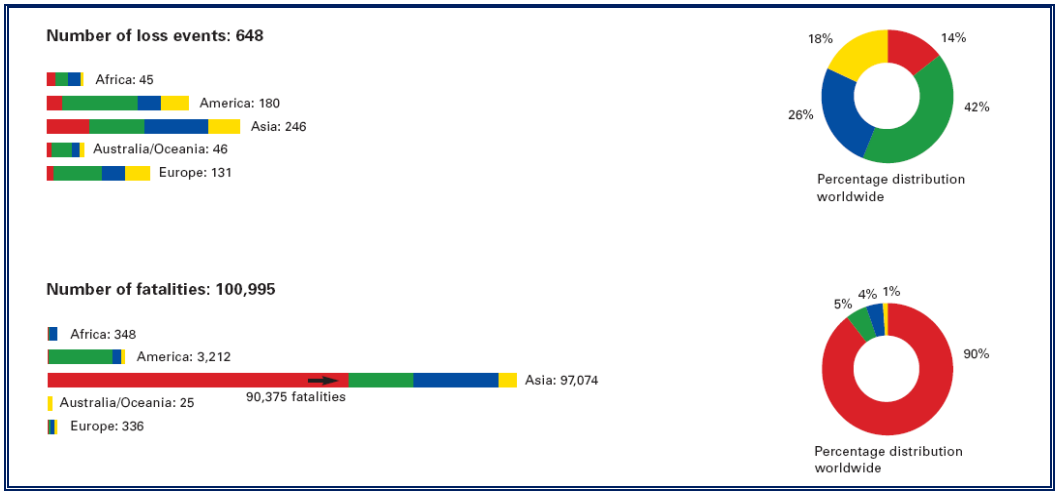
Clasificación JEL: A12; Z00

1. INTRODUCTION

All countries around the world have suffered a large loss of human life and heavy physical and economic damage as a result of natural, technological and human disasters. The impact of such situation on living conditions and national economies is related with their economic performance, the sustainability of their long term development strategies and on the conduction of economic policy, and depends on countries stages of development. In the industrialized countries, tremendous losses are sustained to the capital stock, while losses of life are usually very low because there are effective forecasting and warning systems. On the other hand, in the developing countries, disasters always result in heavy loss of life because there are no organization, prevention and evacuation systems. The impact on economic development is usually considerable, although capital stock losses may be less.

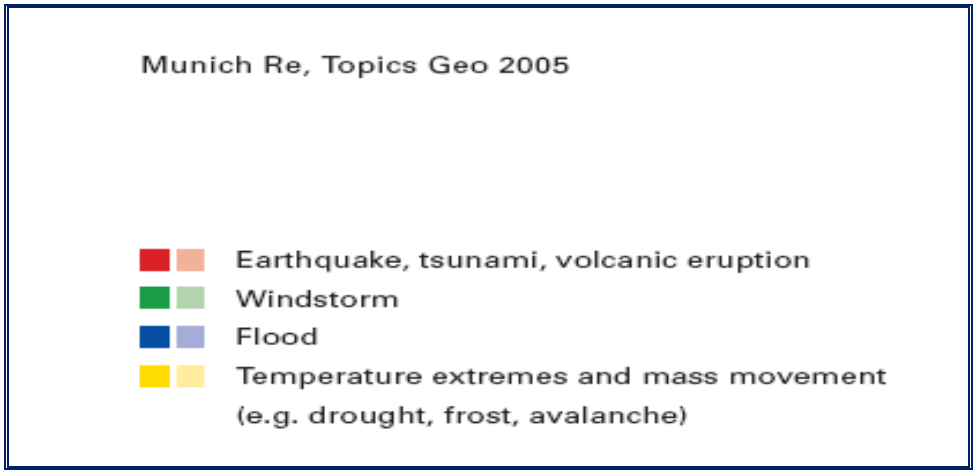
Taking into consideration only natural catastrophes, and based on statistics and additional estimates of Munich Re Group[3], only over the year 2005, around 650 natural hazards were analyzed and stored, with very interesting figures to study. As in previous years, the number of events was dominated by weather-related natural catastrophes. The largest death toll was caused by the Kashmir earthquake in the border region between Pakistan and India, which killed more than 88,000 people and made more than three million homeless.

GRAPH 1-A: Number of loss events and number of fatalities in 2005



Source: MUNICH RE GROUP (2006): *Topics Geo. Annual review: Natural catastrophes 2005*, MunichRe, Munich, pg. 8.

GRAPH 1-B: Explanation graphs in Topics Geo 2005



Source: MUNICH RE GROUP (2006): *Topics Geo. Annual review: Natural catastrophes 2005*, MunichRe, Munich, pg. 8.

In number of events Europe represent 20% (131 events in Europe over 648 global events) of the total percentage distribution worldwide with 131 events, although in number of fatalities Europe only represent the 0,33 % (336 fatalities in Europe over 100.995 global fatalities) of the total worldwide distribution, with 336 fatalities in 2005 (GRAPH 1).

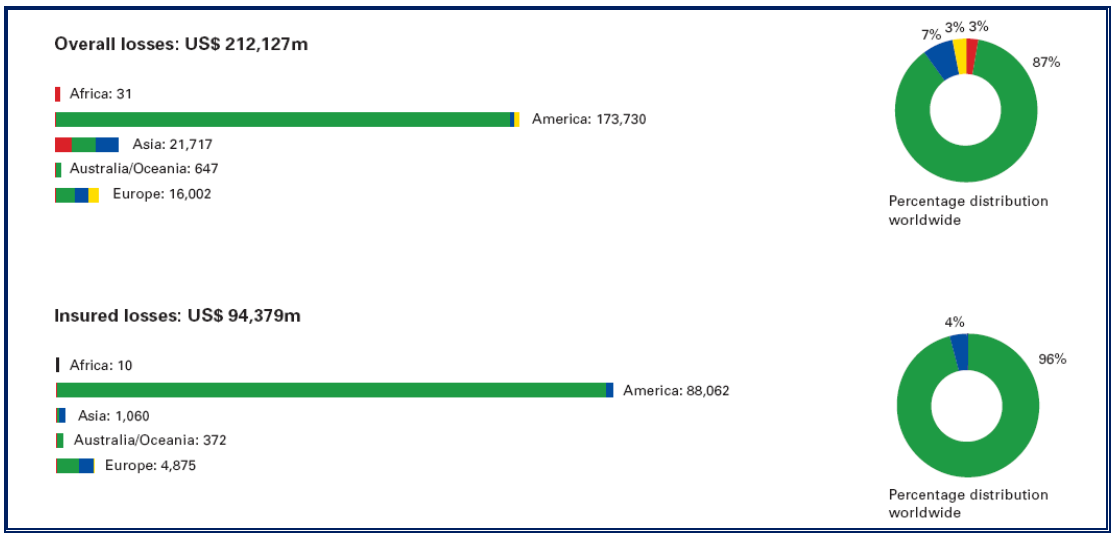
One of the reasons of such divergence between the number of events and the total fatalities amount is related with the fact that European countries are included in the group of countries with the highest Gross National Income (GNI) per capita, classification used by the United Nations (International Decade for Natural Disaster Reduction – IDNDR)[4] for comparing the various economies. In the same line IDNDR indicates that:

- the countries with the highest frequency of natural catastrophes are the rich countries;
- the countries with a high per-capita income come off much lighter about of loss of life; and,
- the rich countries bear the main economic losses in absolute terms.

The economic losses in developed countries (groups 1 and 2 of the World Bank[5] classification) affects to a large proportion of the population, generally the lower-income population, and is a mayor setback for governments´ development efforts. 2005 was a record year: the most expensive natural catastrophe year in insurance history and for the world's economies as a whole. The hurricane losses in North and Middle America and in the Caribbean caused roughly 80% of the overall economic losses and 88% of the insured losses.

Taking into consideration the European frame figures, the amount of overall losses bring up to 212.127 US million dollars, were Europe participate with the 7,5% (16.002 US million dollars). The figure is also less important in the worldwide distribution taking into consideration the insured losses: a total of US$ 94.379 million worldwide versus US$ 4.875 million in Europe, what means a 5% of the global insured losses distribution (GRAPH 2).

GRAPH 2: Overall losses and insured losses in 2005



Source: MUNICH RE GROUP (2006): *Topics Geo. Annual review: Natural catastrophes 2005*, MunichRe, Munich, pg. 9.

In such situations, each country bears the primary responsibility for protecting its people, infrastructure and other national assets from the impact of disasters and for taking steps to reduce the vulnerability of populations in areas at risk. For these and other reasons, government and other institutions are willing to set up and develop new and different measures, strategies and programs with this aim and also the development of infrastructure, institutional strengthening as well as the improving of the economic and financial efficiency.

This paper, as a brief summary of the related EU project presentation, tries to obtain new elements to get a uniform and comprehensive methodology for the quantification of the economic effects of a disaster in the European Union framework with two priorities:

a) those methodologies should allow the decision making about disaster prevention, mitigation and preparedness measures as well as rehabilitation and reconstruction programs; and,
b) methodologies are important as a tool for the adoption of decisions on the direction and priorities about geographical and sector investments.

2. STEPS TO QUANTIFY THE ECONOMIC EFFECTS OF A CATASTROPHE

The final aim of the whole research project is to establish indicators that would assist individuals and institutions involved in the identification and quantification of damage caused by natural disaster, by providing them with new key elements to perform a uniform and coherent methodology. This paper shows the objectives and process that the Economic Research Group[6] of this EU Project wanted to develop, always as a part of the global research group. As a result of the whole work, government and institutions will yield most of the information needed to identify the social or economic sectors or geographical regions which must have the priority in the rehabilitation and reconstruction process.

As part of the specific Economic Research Group aims, the evaluation and quantification of the economic consequences of a disaster should be divided into two temporary phases: pre-disaster and post-disaster phases. While the traditional disaster evaluation is focused on post-disaster effects, the preparedness and mitigation measures must be necessarily accounted as a disaster cost, or more specifically as a reduction in the post disaster cost. The post disaster period is usually divided in three phases:

a) the emergency and response phase;
b) the rehabilitation and recovery phase; and,
c) the reconstruction phase.

When a disaster occurs, along with the first emergency measures taken by the government and the community impacted, various national and international agencies offer relief, aid and assistance. This support is very important, but only represents part of the total cost of the necessary process of post disaster recovery. For this reason, one of the most important tasks for the country concerned is to make an early, reliable preliminary assessment of damage. The traditional evaluation is carried out during the emergency phase. However, it will not be easy to obtain the information needed to evaluate the magnitude of the direct damage, still less the indirect and secondary effects. It is absolutely essential to identify and quantify its effects as accurately as possible, although is also necessary to wait until the first emergency activities were completed for not interfere with the relief efforts. However, it is important not to wait so long because the result of evaluation is needed for designing rehabilitation and reconstruction programs and for identify how international cooperation have to be channeled. Socio-economic quantification is, at it is seems, extremely difficult.

It is also difficult to look for a comprehensive and uniform methodology for evaluating those socio-economic effects, and much more with the aim to be a tool for the adoption of decisions on the direction and priorities of rehabilitation, recovery and reconstruction plans and programs.

In order to set up the bases to work on such direction and to develop such a methodology some steps would be followed:

1. The art state of studies and researches
2. Damage assessment
3. Simulation and modeling

2.1. FIRST STEP: The art state of studies and researches

The first step for developing a uniform methodology for quantification of economic effects of natural disasters is to compile and systematize the experience gained by governments as well as for professional and other non-governmental organizations, particularly scientific and technological societies, humanitarian groups and investment institutions. Actual and ongoing researches within the European Union and other international Organizations must be evaluated and considered in order to decide about the variables and analyzers of the economic effects of catastrophe as well as to extend a uniform methodology.

The suggested methodology for this step is:

- to compile and systematize the experience and researches;
- the comparison of available information; and,
- data analysis.

2.2. SECOND STEP: Damage assessment

The evaluation of natural disaster should not only have into consideration immediately perceptible effects, such as those caused by earthquakes, fires or floods. They also have to include consequences that develop slowly or appear only long after the event. One of the most extended classifications[7] of the natural disaster effects divides them into direct damage (effects on property), indirect damage (effects on production flow of good and services), and secondary effects (effects on the behavior of the main macroeconomic aggregates). The first damage coincides with the disaster while the other two effects occur within hours of it or over a period of time between two and five years depending on the magnitude of the disaster. This classification allows a full assessment of the disasters´ socio-economic impact at the time it occurs, and also of its subsequent effects.

To facilitate understanding of the variables and analyzers used in the study, it is interesting to describe the kind of damage to be included in each of these three categories of effects:

2.2.1. Direct Damage

Direct damage refers to physical destruction, that occurs simultaneously or immediately after the disaster and is related to fixed assets, capital and inventories of finished and semi-finished goods, raw materials, and spare parts. It includes total or partial destruction on immovable assets and inventories such as physical infrastructure,

buildings, machinery and equipment, furniture, transport and storage facilities, damage to farmland and soils, irrigation and drainage works, dams, crops ready to harvest, etc.

The estimated cost of demolish and clearing areas where there has been destruction and the cost of the emergency response or, in some cases, the preparedness and mitigation costs should be considered and accounted as direct damage.

2.2.2. Indirect Damage

Indirect damage refers to damage to the flow of goods that will not be produced and of services that will not be provided after the disaster strikes. The period of quantification begin immediately after the disaster and run over months or years depending on the type and characteristics of the disaster.

Indirect damages are measured in monetary terms and may include, at least, the following kinds:

- increased operational expenditures in a given sector due to the destruction of physical infrastructure or inventories, and increased costs for the provision of services;
- additional costs incurred in a given sector or activity due to the need to use alternative ways of production or for the provision of a service;
- losses of income as a result of the non-provision of services in utilities and losses of personal income in the case of individuals losing their way of live;
- unexpected expenditures related to meeting "new" needs arising from the disaster;
- production or income losses caused by a "chain" reaction similar to that occurring in a recession;
- investments incurred to respond to the need to relocate fixed assets or activities to safer areas after a disaster; etc.

2.2.3. Secondary Effects

Secondary effects refer to the impact of the disaster on the overall economic performance of a country measured through the most significant macroeconomic variables. The estimation of changes in these variables due to the disaster is already measured by direct and indirect damages, but is necessary this different point of view because they cannot be mathematically added to express the total amount of damage.

A disaster's main secondary effects are those which have an impact on:

a) The overall and sector “gross domestic product” (GDP).
   Gross domestic product can be reduced by the anticipated decline in the output of sectors that sustained direct and indirect damages; it can also grow due to the surge in the construction sector as a result of rehabilitation and reconstruction activities;

b) The "balance of trade" and the "balance of payments".
The balance of trade and the balance of payments can be affected due to export shrinkage resulting from diminished output, and by increased import requirements to face internal demands and the requirements of rehabilitation and reconstruction;

c) The "level of indebtedness and of monetary reserves".
Reconstruction efforts may involve acquiring or increasing foreign or local indebtedness; depending on the economic position of the country prior to the disaster and if the secondary effects are sufficiently large, it is possible that the country's international reserves and its ability to meet external commitments can be jeopardized.

d) The state of "public finances".
Public sector spending grows to meet the needs of the emergency and rehabilitation phases and tax revenues may shrink because of reduced output and diminished exports, which may combine to create or increase fiscal budget deficits;

e) The amount of "gross capital investment".

f) **"**Inflation".
Prices may go up because of shortages or speculation, thus creating or worsening inflationary pressures on the economy;

g) "Employment levels", and,

h) "Household income".

2.3. THIRD STEP: Simulation and modeling

This step will allow finding key elements and indicators to develop a comprehensive and uniform methodology for quantification of economic effects of natural disasters with the priorities previously established. After the exhaustive compilation of quantitative information and their systematization held in the first step, and the second step focused on post disaster damage assessment, the project is ready to develop their third step: the election for the best objectives adapted methodology or methodologies.

Nevertheless, on the time to choose the best methodology or methodologies for the quantification of the economic effect of catastrophes that allows decision makers to establish prevention and mitigation strategies as well as recovery measures, it is important to look for same factors that limit the available options:

1) The first factor to consider is related with the pre-disaster socioeconomic conditions. It is very important to distinguish between developed and underdeveloped countries. The economic and social differences of those country´ groups get very different disaster impacts and respond capacity. The available information data and their sources are also very different. Within the developed countries there are regional and national differences that must be considered.

2) The second factor is a temporal limitation. It is essential to delimitate the post disaster studied period, because the impact in some macroeconomic variables will get a long time to be measured. Remember that indicators and other data refereed to disaster will suffer a long delay to be published.
3) The third limitation is the geographical factor. If the analysis has a very narrow focus, i.e., local or regional, there will be problems in their quantification because information, data and statistics for such desegregation levels could be not available. On the other hand, and incident considered disaster at local or regional level would not be important at all at national level. Those problems also could arise if the focus is too extensive, i.e., more that national level because there is not so aggregated available data.

Taking into consideration all those limitations decision makers could use different methodologies for the quantification of the economic effects of a catastrophe in the European context. Some of those methodologies that the study suggests are: Inputs-Output impact models (IOT), macro-economic analyzers (gross domestic product, employment levels, etc.), cost-benefit analysis, computable general equilibrium models, simultaneous equation econometric models, etc. Almost all of those methodologies allow simulations to study and to compare the economic situation in different time periods and different scenarios. Those simulations would be possible depending on the data available and the aim of the process.

3. A METHODOLOGICAL PROPOSAL FOR THE QUANTIFICATION OF THE ECONOMIC EFFECTS OF A CATASTROPHE IN EUROPE

The proposed methodologies for the quantification of the economic effect of catastrophes need a temporal development that should be studied within three phases:

3.1. FIRST PHASE: pre-disaster situation

This phase is focuses in the description of the studied area in order to identify possible limitations or problems and the possibility to obtain an idea of the economic situation as short as possible to the catastrophe date. This is an ex-ante approach that requires a modeling methodology that permits the forecasting or simulation of losses. The analysis should be geographical and temporal limited in order to establish a framework to relate the main social, economic and political characteristics (public intervention, emergency preparedness, etc.) in a pre-disaster situation.

The Economic Research Group proposes for the quantification of mitigation and preparedness in the pre-disaster situation three complementary methodologies that could be used depending of the information available and the deep of the valuation requested.

1. The first of the three methodologies to describe the pre-disaster economic situation are the "Inputs-Output impact models (IOT)". Those tables show a quantitative vision of the interdependency of the different economic sectors and the magnitudes that represent them. This methodology has some advantages:
    - first, all European countries have accurately and uniform data as well as the IOT;
    - second, because of the use of uniform data, the analyzers and indicators are comparable;
    - third, from the accounting point of view this is a compiling statistical data methodology, that consist in aggregate activity sectors and quantify the relations and flows between them (internal consume);
    - fourth, allows to know the production of each activity sector and their proportion on the final demand (consume, capital, exports, etc.), or the use of essential factors (capital and work).

    The IOT offer a quantitative expression of the internal flows between the different activity sectors, quantification that do not offer any other accounting methodologies.

2. The second methodology included in the study allows to do a deeper analysis as well as to complete the information given by IOT. We are speaking about the "Computable General Equilibrium" models, based on National Accounting, that aggregate the economic information into accounts, by sectors or activities, showing the different parts of the productivity process.

3. The third methodology aggregates a group of complementary "Indicators" about prices, employment, etc., that get information not included in the other two methodologies.

3.2. SECOND PHASE: damage assessment on response phase

To be able to make decisions regarding to the priorities of response and to the recovery strategies and rehabilitation it is essential to carry out a correct and quick balance of the damages caused by the catastrophe, as well as its immediate consequences keeping in mind the possible indirect and secondary effects that can take place on the affected area, i.e., the country or countries affected. This is a micro-economic valuation that uses fundamentally Computable General Equilibrium Models (accounting). This valuation will allow to establish priorities to assist the affected population and their more immediate and basic necessities. At that point, it is useful to use the traditional classification of the catastrophe effects that divide them in three groups: direct effects

(on the patrimony), indirect effects (consequences in the flows of goods and services) and secondary or induced effects (behavior of the macroeconomic indicators).

This second phase is focused in the valuation of the effects of a catastrophe in the emergency phase and response phase, getting mainly the valuation of direct effects (destruction of infrastructures, interruption in the supply of the water, loss of human lives...) and leaving the valuation of the other two effects for the third phase.

3.3. THIRD PHASE: post-catastrophe macroeconomic valuation (half term)

This is probably the most important phase in the whole process since it has been configured to know, or at least to estimate in a very approximate way, the macroeconomic effects that the catastrophe has taken not only in the country or affected region but also in the whole European Union. Given the integration and globalization level, any impact on financial, commercial shock, etc., spreads quickly in the whole frame of the European Union.

The methodologies that intends for the valuation of the economic effects of the catastrophes in this third phase, are the same methodologies suggested in the first phase: the IOT, the computable general equilibrium models and the macroeconomic indicators. The three proposed methodologies are complementary in function of the necessities and the readiness of information, and they will be used in function of the depth that is wanted for the analysis.

The really important thing in this phase is to be able to carry out a comparative analysis among the different methodologies pre and post catastrophe, being in fact the variation in the different methodologies that provides the total cost of the disaster. Also, the proposed process, allows to carry out simulations among the different activity sectors and to see the implications that any change causes in the rest of the economy, even in the future, for what allows to be carried out reliable predictions. Within this suggested simulations methodologies, and only as a very initial suggestion, that could change with variation of several points, the idea of this Economic Research Group is to use the Montecarlo Simulation Methodology.

4. CONCLUSION

This paper is only a brief summary of the presentation that the Economic Research Group of the project developed to the Core Group. This presentation brought the opportunity to discuss with the whole Research Group the best practices to run the project.

Within this line, since the economic perspective, the proposed methodology based on the Input-Output Tables, the National Accounting and the macroeconomic indicators, cover almost all the aims of the project and have important advantages:

- the existence of homogeneous and harmonized data in the whole UE;
- it is a simulation model and projection that allows to make an analysis of the incidence of certain alterations of prices, final demands, production, capital, etc.; and,
- it evaluates the alteration of the commercial and financial relationships with the rest of the world.

This Research Group believes that a combination of Input-Output Tables, the National Accounting and the macroeconomic indicators get real keys to develop a comprehensive and uniform methodologies for the European frame that would allow decision makers to evaluate the economic effects of the disasters in a reliable way for the adoption of decisions about rehabilitation, recovery and reconstruction programs, as well as the establishment of geographical or sectored priorities for investment.

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[1] Este trabajo es un extracto de la presentación realizada por el Grupo de Investigación de Economía ante el Comité de Dirección del "PROYECTO MAYOR EOROPEO: ASPECTOS SOCIO-ECONÓMICOS DE LAS CATASTROFES" (EU PROJECT: SUB / 00 / 287037), financiado por la Unión Europea en el contexto del Plan de Acción Comunitaria a favor de la Protección Civil (1999 / 847 / CE), perteneciente a la Dirección General XI de la UE (anexo 15 al documento del Comité PC 3 / 3 / 1), Marzo 2005.

[2] This paper is based on the presentation that the Economic Research Group developed to the Core Group of the "EUROPEAN MAYOR PROJECT: SOCIO-ECONOMIC ASPECTS OF CATASTROPHE" (EU PROJECT: SUB / 00 / 287037), financed by the EUROPEAN UNION, March 2005.

[3] MUNICH RE GROUP (2005): *Topics Geo. Annual review: Natural catastrophes*, Münchener Rückversicherungs-Gesellschaft, München, pg. 8-9.

[4] UNITED NATIONS INTER-AGENCY SECRETARIAT OF THE INTERNATIONAL STRATEGY FOR DISASTER REDUCTION (UN/ISDR): *World Conference on Disaster Reduction,* Yokohama, Japan, 23-27 May 1994.

[5] For operational and analytical purposes, the World Bank's main criterion for classifying economies is gross national income (GNI) per capita or gross national product (GNP). Based on its GNI per capita, every economy is classified as low income, middle income (subdivided into lower middle and upper middle), or high income. Other analytical groups based on geographic regions are also used by the World Bank.

[6] The Economic Research Group of the European Union Project (EU PROJECT: SUB / 00 / 287037) was initially integraded by Ana Fernandez-Ardavín Martínez and Isabel Martínez Torre-Enciso.

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