THE PROJECT

COMPLEX SYSTEMS IN ECONOMICS

Italian Government

Minister for the University, Scientific and Technological Research (Rome)

National strategic project
"Dynamics of Complex Systems in the Field of Economics"

"THE EMPLOYMENT OF SOFTCOMPUTING TECHNIQUES"

SCIENCE PARK (Trieste)   and   UNIVERSITY of TRIESTE

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PROJECT OBJECTIVES

The research involves

- **The description of the emergence of vulnerability and risk in various areas of economics**

- **Economic systems, i.e. political, financial and economic risk (elements of country risk)**

- **Enterprise and Financial Markets, i.e. operating risk, financial risk, and distress risk**

continued

- **Researching factors that produce instability and chaos**

- **Discovering new organizational principles (of economic systems, enterprises and financial markets) following a complex systems approach**

INTERESTED ORGANIZATIONS AND INSTITUTIONS

- **Government**

- **Central banks**

- **Savings markets**

- **Institutional investors**

- **Insurance companies**

BRIEF OUTLINE OF THE PROJECT

Researching new models in the field of Economics by the application of the logic of complex systems dynamics

S C O P E

- **The economic system in general**

- **The territory of enterprise**

- **The structure of financial markets**

SOME SPECIFIC INTENTIONS OF THE INVESTIGATION

**Awareness of the presence
of risk
in all parts of the analysis**

IN DETAIL

Typology of vulnerability and risk in any entity or system under consideration

- **In the economic system   - country risk**

- **In the territory of enterprise   - operation risk**
  - financial risk
  - distress risk

continued

- **In the financial markets**

  (trade-off risk/return of equity securities)

- **intertemporal preference rate (risk free)**

- **financial risk premium**
- **full risk premium**

- **Financial markets**

  (trade-off risk/ return of bonds)

- **intertemporal preference rate (risk free)**
- **high yield bonds, rating and default risk**

OBJECTIVES (2)

The recognition of possible links between methods used and results obtained on the basis of economic theory

- **Fisher Theory**
- **Modigliani and Miller Theory**
- **CAPM and market models**

Methods used in each section of analysis (country risk, enterprise risk, financial markets risk) should result in –

- **success in discovering new organizational principles applicable to each system –**

- **Equilibrium simulation**
- **Periodic motion of phenomena**
- **Chaotic behaviour of phenomena**

- **identification in each system of internal or external forces representing *tools of attraction* in conditions of *agreement* or *disagreement***

- **To extend to Economics some important principles and categories of Physics –**

  Concept of dimension
  Concept of mass (inertial or gravity)
  Concept of speed and type of motion
  (uniform, accelerated)

- **The placing in the analysis of some concepts of "prospect theory" for interpreting utility functions (Prof. Kahneman)**

DATABASE

Type of information
applicable to every
country

- Political information. TI's
- Corruption Perception Index
  Level of take-over defence
  in every country
- International monetary
  environment
- Foreign exchange rate
  determination
- Foreign exchange market
- Public economic information
  (GDP, Y,I,C, Importing,
  Exporting)

ENTERPRISE RISK

Type of information in the global system

- off-line database consisting of company balance-sheets

- off-line database consisting of statistical information – production sectors

- on-line database – Bloomberg, Data-streams, Reuters

FINANCIAL MARKETS

Type of information in the global system

- **Market segmentation**

- **Emerging capital markets**

- **International portfolio diversification**

- **Trend and cycles of securities**

- **Market indexes**

- **Stock exchange book**

FEASIBLE OBJECTIVES (1)

Researching the principles of organization of economic systems (country systems, financial markets, systems of production) which produce stability or, conversely, generate instability and, in addition, the development of "softcomputing" techniques for the purpose of analysis of those principles.

FEASIBLE OBJECTIVES (2)

The creation and implementation of database systems, essential for empirical study, their application to complex systems in the areas above mentioned, and to model tests.

FEASIBLE OBJECTIVES (3)

The construction of forecast models of risk (operative, financial, default) by the application of softcomputing techniques (including neural networks and genetic algorithms) able to define the systems under consideration and to reproduce trade-off risk yield in non-linear terms

FEASIBLE OBJECTIVES (4)

The creation of platform prototypes (software modular) for the analysis and evaluation of country risk, of country insolvency risk and of financial markets risk (operational, financial and default)

FEASIBLE OBJECTIVES (5)

The use of the EGRID data system of operation for access to and sharing of information and results, and the creation of an interface of "facility" platform prototypes (see previous note) and the implementation (representing considerable innovative importance) of a connection between the two systems

AREAS OF ACTIVITY

- **Extensive bibliographical research, the determination of the principal economic-financial parameters for for exact analysis, and the selection of new numerical methodology**

- **Grouping of data and the creation and organization of personalized data banks, essential for the development of empirical study**

continued

- Comparative use of the Gaussian processes, neural networks and genetic programming for the understanding of the reaction of the systems under study in cases of instability
  Creation of forecast models of risk

- Creation of a platform (software modular), its interaction with the data bank (see Area of Activity 1) and its connection with the EGRID system of operation

Area of activity 1 : Extensive bibliographical research, the determination of the principal economic-financial parameters for exact analysis, and the selection of new numerical methodology

Coordinator – *prof. Maurizio Fanni*

- The activity provides for extensive bibliographical research and classified bibliographical documentation
- Critical reading of the studies already undertaken, especially in the field of economics, and of methodology able to interpret complex phenomena, represents a significant stage in the research as a whole and forms the phase of identification of both strong and weak points which result from the merging of various areas which, though widely dispersed, reach sufficient integration

Area of activity 2 : Collection of data and the creation and organization of personalized data banks, essential for the development of empirical study

Coordinator: *prof. Maurizio Fanni*

Relevant sources are represented by data bank archives supplying information, in both paper and digital forms, with reference to company balance-sheets, both quoted and unquoted

Data processing for the purpose of "personalization" which should lead to the ordering of usuable information for analysis and be in line with modern financial developments

Area of Activity 2 : Collection of data and the creation and organization of personalized data banks, essential for the development of empirical study.

Coordinator: *prof. Maurizio Fanni*

Relevant sources are represented by series of archival data (share and bond prices) of various financial markets, the trend of domestic and global indexes with extensive temporal analysis, risk and vulnerability indicators of the same markets, Rating indicators, etc), organized and diffused by specialized bodies at different times. Data processing with the aim of "personalization" should lead to the arrangement of usable data for analysis and be in line with the evolution of Modern Finance.

Area of activity 3 : Comparative use of Gaussian processes, neural networks and "genetic programming" for the understanding of the response of the systems under investigation in cases of instability. The construction of forecast models of risk.

Coordinators: *prof. Maurizio Fanni and prof. Carlo Poloni*

With the aim of an overall interpretation of the structure of the said markets (efficiency, stability, significance of the temporal horizon of the investor, conditions of "self-similarity", persistance and non-persistance of securities yield and of market indexes), as well as an explanation of reactions in cases of instability and in contexts of chaos, the various aspects will be treated in comparison by the use of Gaussian processes, neural networks and "genetic programming".

Area of activity 3 : Comparative use of Gaussian processes, neural networks and "genetic programming" for the understanding of the reaction of the systems under investigation in events of instability

Coordinators: *prof. Maurizio Fanni and prof. Carlo Poloni*

- The emergence of models based on "measuring memory" research in the areas under investigation.   In general, these will be "nonlinear dynamic systems" able to offer explanation of the behaviour of the system in its entirety and to manage its vulnerability and uncertainty
* The analysis of systematic risk will be linked to the level of borrowing and to economic cycle trends in a global perspective

Area of activity 3: Comparative use of Gaussian processes, neural networks and "genetic programming" for the understanding of the reaction of the sytems under investigation in cases of instability

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- The procedure will be the application, for the purpose of risk management, of the algorithms realized in areas of activity 3a and 3b
- The application of models *ad hoc* of the state of company distress and similar models relative to securities and hedge funds (measurement of the probability of insolvency with the assistance of VAR type analysis) with consideration of the consequences of default on financing bodies (financial intermediaries and institutional investors)
- The role of company risk cover will be studied and a financial market structure will be realized in the context of asset liabilities management

Area of activity 4: The realization of an information platform (software modular) its intereaction with the data bank of area of activity 2, and its connection with the management system EGRID

Coordinator: *prof. Carlo Poloni*

- The research group transfers and shares, in the EGRID distribution system, the results of their individual research in the interest of all participants thus allowing the scientific sectors involved to make use of advantages generable to the national facility
- To that end, the research group proceeds to the prototyping of software with the modelling and the numerical methodology created in previous areas of activity, leading to all the necesssary intereactions for a first class software connection with the EGRID system

Area of activity 4: The realization of an information platform (software modular), its intereaction with the data bank of area of activity 2 and its connection with the management system EGRID

Coordinator: *prof Carlo Poloni*

- In general. At the conclusion of activity the research group proceeds to strengthen the interface of the software created with the EGRID data management system, developed by the ICTP project, in order to make efficient use of the data base
- Concluding activity will be generally organized to resolve and implement the connection between the two systems