

“The new geopolitical and geo economic structure of the Scientific Knowledge”

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ABSTRACT

The profound changes occurring in the international system over the past 20 years have occasioned new rules and new world patterns characterized by the phenomenon of globalization, by an exceptional technological revolution, by more actors and a new global agenda of topics more complex and interdependent. All these events generated a necessary theoretical debate and empirical investigations on how these changes affect the new international system.

One of the global Agenda new topics is the Scientific Knowledge. At the beginning of the 21st Century, the scientific knowledge has acquired a significant economic value that generates a very strong impact on the economic, social and political system. The new aspect is that it becomes central to this new stage of capitalism, and a main source that generates economic richness, political power and social development.

All these changes have made a deep impact on the geopolitical and geo-economic structure of the scientific knowledge, as well as in the international actors involved in it and in the changing aspects of interaction; as cooperation, conflict or competition that occurring among the different actors, administrators and transmitter of scientific knowledge. The geopolitics of scientific knowledge becomes a key factor that is trying to shape the New World Order characterized by a knowledge society.

This investigation from a systemic perspective and the use of Science and Technology (S&T) indicators could be an academic key explanation on the field of International Relation and Social Science, using it as a new approach. Pursuing this idea, the present doctoral investigation is working with global system schemes and with variables, dimensions and indicators on S&T in order to discover new answers of the role of scientific knowledge.

1. RESEARCH TOPIC

1.1 Introduction

Since 1990, with the end of the Cold War, we are living in a new world that has experienced deeply changing in the main patterns and rules of relations among actors in the world system. The profound changes occurring in the international system over the past 20 years have occasioned a complex new world, characterized by the phenomenon of globalization /internationalization and an exceptional technological revolution. We have passed through a simplified old bipolar system to a new complex, turbulent and multipolar system (Rosenau, 1997).

1.2 New World Order after Cold War

In the last two decades of the 20th Century, the world entered in a vertiginous process of interdependence, driven by political and institutional changes on world-wide scale (implosion of the

Soviet system, the end of the Cold War, collapse of the international order post Second World War period) and a technological revolution that reduced the factors of time and of distance between countries, institutions and individuals (new technologies in communication, information and systems production).

This new context supposed a radical change in the international system, which generate structural transformations in the political, economic, social and cultural spheres, and take steps toward a new world order. The majority of the international experts agree with the idea that we are crossing a new stage in the system of the international relations, characterized by the change, the contradiction and the complexity (Petrasch, 1998).

The end of the Cold War and the dissolution of the Soviet Union; the new tendencies towards the globalization and regionalization; the erosion in the role of the Nation State (Strange, 2001); the evolution towards a new phase of the Capitalism characterized by the internationalization of the production and the global finances; the coexistence of a great number and variety of state and non-state actors in disorderly situation and highly interdependent to each other (Risse, 2002); and, the emergent of a global agenda of topics more numerous and complex, are some of the main characteristics that shape the new international configuration.

1.3 Globalization and Technological Revolution

In spite of a short time happened within this new stage, it is possible to recognize some of the main characteristics of this cycle. Especially two circumstances should be mentioned: the Globalization and the Technological Revolution. In the first case, even though it seems a very ambiguous and controversial concept, we are living in a highly globalised, interconnected and interrelated world, at least, in economic, financial and communicational terms.

At the same time, the essential factor in this whole change process of globalisation has been the spectacular technological revolution of the last few decades. We began to use the concept of Global Village, in which the mass media communication and transport have strengthened the links and relations between each corner of the planet. It is a revolution that has affected the essential structure of the system and the technological development is modifying every single part of our life. The application of the technology to the data processing and the communications are having a decisive impact in political, economic, social and cultural activities.

1.4 Role of Scientific Knowledge

One of these new topics of the international Agenda is, without doubts, the Scientific Knowledge. The knowledge becomes a key factor that is trying to shape the future World Order characterized by a Knowledge Society.

The deep impact that the technological revolution is generating, has special incidence in the scientific knowledge and in the role that is playing in the international system. The scientific knowledge has acquired a renewed economic value that has transformed in a resource extremely appreciated by the majority of the actors of the new international order.

At the beginning of the 21st Century, the Scientific Knowledge, usually associated with political and economic power and social geopolitical patterns, acquires supremacy and special relevance. This is in part, because the scientific knowledge has been acquired in recent years a significant economic value that generates a very strong impact on the economic, social and political system. Even though, scientific knowledge has been an important factor in advanced societies; the new aspect is that it becomes central to this new stage of capitalism and a main source that generates economic richness, political power and social development (Quintanilla, 2007).

All these changes have had a strong impact on the geopolitical and geo-economic structure of the scientific knowledge, as well as in the international actors involved in it and in the changing aspects of interaction that occurring between the different actors of knowledge.

1.5 The main Actors of Knowledge

The new strategic value of the Scientific Knowledge has generated a clear recognition from the majority of the international actors and a necessity to bet in Science and Technology (S&T) as a crucial and decisive element in the generation of wealth in order to build an economic, social and political development.

This notion is based on the idea on which the economic growth depends, principally, of the knowledge and the human capital as basic input of the development. At present, there is a widely consensus that the wealth and the possibilities of development of a country are highly associated to the consolidation of a strong sector of science and technology and a critical number of researchers and scientists. With this objective in mind, most of the international actors in charge of the creation, management and transmission of scientific knowledge begin to plan investments oriented directly to increase the expenditure on Research and Investigation (R&D).

The main international actors who participate in the creation, management and transmission of the scientific knowledge are essentially four: the governments, the companies, the universities and the NGOs, each of them with their own characteristics, dynamics and models of interaction.

The Nation States, the traditional units of analysis of the International Relations, have begun a strong race for the scientific knowledge. Not only the governments called classic Triada of knowledge (USA, European Union and Japan) are investing on S&T but also new emergent countries like China, Brazil, India or Russia (UNESCO, 2010b).

The enormous development of the economic sector, led by the financial system, has put in scene a new and powerful international actor: the Transnational Companies. They are pressing by the control of the scientific knowledge, not only to redefine the way in which transmits knowledge, but also they are assuming the task of creators of knowledge. (Slater, 2008)

The University, the traditional actor in charge of the functions of creation and transmission of the scientific knowledge, is now put under multiple challenges. Some analysts consider that the New World Order has reserved for the university a new place of privilege (Albatch and Knight, 2006)

others, on the contrary, understand that the university organization can become a marginal and disposable institution that need to adapt itself to the strong systemic changes. (Enders and Fulton, 2002)

Finally, during the last decades, the Non-Governmental Organizations have become a relevant new international actor. Think Tanks are public policy research institutions that create new knowledge through collaboration with different public and private actors. The proliferation, global expansion and networking of them in the last years have shown the potential of these actors on the future of the role of scientific knowledge. (Think Tanks and Civil Societies Program, 2010)

These four international actors considered the main players connected to the scientific knowledge are suffering a strong reconfiguration of their classic functions; their role as international actors; and, on the way in which they relationship with other players.

All this new international framework, topics, actors and dynamics generated a necessary theoretical debate and empirical investigations on how these changes affect and impact the new international system.

2. RESEARCH QUESTIONS

It was and will be very relevant for this work, for the author and for the future of this PhD investigation to follow a variety of questions and challenges that the entire research will face, in order to understand the main keys of the future of Scientific Knowledge on the world system.

These questions that guided the whole investigation can be divided in 2 types:

2.1 Approaches and methods

- 1- What are the new approaches in Scientific Knowledge studies?
- 2- How do we translate our researching intentions on methodological actions?
- 3- It will be possible to investigate on Social Science and International Relations by using Science and Technology (S&T) Indicators?
- 4- Will the geopolitical and geo economic level be a renew approach to research on Governance on Scientific Knowledge?
- 5- Could the investigation with Systemic Perspective be one of the new approaches on the study of the role of Knowledge in the new international order?
- 6- Could the Variables, Dimensions and Indicator on S&T help us to discover new information and analysis about the role of knowledge on international system?
- 7- What will be the role of qualitative and quantitative methods on the future of our investigations on the field of international studies?

- 8- Should we think in new methods and techniques in order to get information and process the data?

2.2 Concepts and topics

- 1- What is (or) will be the role of Scientific Knowledge in the New World Order?
- 2- Are we really living in a Society of Knowledge or in an Economy of Knowledge?
- 3- Will the Scientific Knowledge be one of the most important resources of global power in the future?
- 4- Which are the main international actors that will create and manage the Scientific Knowledge in the world post-Cold War?
- 5- Are the states, companies and institutions (universities, NGOs, etc.) thinking and working about the future and the potential role of Scientific Knowledge?
- 6- Are the main international's actors investing on it?
- 7- What kind of dynamics (cooperative, competitive, conflictive, dependence, etc.) can the scientific knowledge generate among actors?
- 8- Are we going toward a more democratic, equal and multipolar new geopolitical and geo economic structure of scientific knowledge or, on the contrary, toward a more concentrate, unequal and unipolar?

3. HYPOTHESIS

The main hypotheses of this research refers to the transition to a new international system after the Cold War period that has modified the geopolitical and geo economic structure of the Scientific Knowledge, and has created a new one, characterized by the participation of new actors; by producing a new dynamic of interaction and linkage between the international actors who participate in the creation, management and transmission; and by the configuration of a structure more unequal, multi-polar, conflictive and competitive of the scientific knowledge in the international system.

4. OBJECTIVES

Following this introduction to the present doctoral investigation; after knowing the topic; and the fundamental questions that guided the study and the hypothesis, it is necessary to mention the main objectives for this research.

The main objective is to describe, analyze and explains geopolitical and geo-economic changes that have occurred in the new structure of scientific knowledge.

This global objectives will be possible by identifying the main international players involved in the creation, management and transmission of such knowledge (states, companies, universities, NGOs); by detecting the specific interests that have each of them in Science and Technology (S&T); by recognizing the new interaction aspects between them (cooperation, conflict, competence, dependence); and finally, by knowing the main characteristics and configuration of the new structure of scientific knowledge.

5. THEORETICAL DEBATE

5.1 *Classic debate about the role of Scientific Knowledge*

Science and Technology (S&T) were traditionally central elements of the legitimation of the social systems, and this is, indeed, why the Scientific Knowledge cannot be only considered as an altruistic element, but it must be understood such a significant instrument to increase the power of the people, institutions or countries. (García Guardilla, 2010) On the base of this relation among power, production of knowledge and geographic space, the configuration of geopolitics and geoeconomics of the scientific knowledge has historically been associated to political, social and economic structures of hegemony, dependence or domination. Ferrero and Filibi López (2006) point out that the real important thing is the exceptional relation between knowledge and power or, more specifically, between scientific knowledge and economic and political power, in very concrete and differentiated geographic scopes.

Within the historical evolution of the Scientific Knowledge, the Western world, geographically understood as European and North Americans countries, has occupied a central role in the creation, diffusion and reproduction of the scientific knowledge. Since his expansion initiated during the 15th Century, Western Europe was inserted in a process positioned that the main “geocultural organization” of the world (Wallerstein, 2007), and that was sustained in the idea of Modernity.

The image that the West constructed on itself with respect to his position in the geopolitical structure of the scientific knowledge has been always quite positive, being understood itself as the essential actor of the progress, the universal civilization, the modernity and the economic and social development. According to David Slater this auto perception is constructed on the base of three interconnected ideas: first, is the consideration of the existence in Western world of a series of attributes that are essentially own, like the rationality, the democracy, modernity, the human rights, among others; the second is the interpretation that those attributes are particular of the European and North American development and no product of an historical cultural crossover; and finally, the idea that the development of those Western characteristics is a transcendental step for the whole humanity. (Slater, 2008)

For the tradition of the Western thought the world can be caught by concepts and representations constructed from the reason. From the radical separation between subject/object, original of the Christian thought and secularized by Descartes, the construction of the knowledge can be objective and, therefore, to becoming general and transforming themselves into universal. This auto perception is completed, at the same time, with an image of the non-western world, normally associate with negative things.

On the other hand, a series of academics and intellectuals like Carmen Garcia Guardilla (2010), Walter Mignolo (2003) or Jose de Souza Silva (2008) worked in a very different perspective with respect to the role that played The West in the historical evolution of the scientific knowledge. These authors made a strong criticism to the Western modern thought as the fundamental and hegemonic axis in the world of the scientific knowledge. They argue that the West, at the beginning with the European countries and then with the leadership of the United States, has used their pioneering development and its monopoly of the scientific knowledge through the main and more prestigious university in their own benefit and blocked the rest of the nations. Authors as Mignolo (2003) believe that the knowledge and the science are produced in a certain geographic space, the European West, therefore, the universal legitimation of this knowledge can be considered as an expression of colonialism.

5.2 New perspectives and explanations

In the last decade, the academic debate has widespread in the study of new responses of the role of the Scientific Knowledge in the new international system.

UNESCO as an international organization within United Nations and especially destined to Science, Education and Culture have developed an intense activity of study and investigation trying to analyze the strong changes that have been generated in the field of S&T and the impact on the New World Order.

Proofs of this are the numerous reports and investigations that have been made in the last years where the role of the knowledge within the International System has always had a central position. Although the works published by UNESCO are many, in the last ten years there were three of them that were especially important in the approach of the role of scientific knowledge. These reports are titled: "Towards Knowledge Societies" (2005), "Science Report 2010" (2010) and "World Social Sciences 2010. Knowledge Divides" (2010)

The main task of UNESCO is oriented in the construction of a Knowledge Society that will be source of development for the whole world-wide level. This is exactly why the UNESCO observe with a great preoccupation if the world is being directed towards a dissociated society where the knowledge is distributed of unequal way and where appear notion as Digital Divide and Knowledge Divide to explain the visible differences in the world today.

For UNESCO is obvious that the Scientific Knowledge will acquire more and more importance as a strategic resource and the fight to have these resources will be a fundamental political and economic factor of the new global agenda. This is why many experts consider that in the near future the knowledge will be objective of a hard competition between the diverse international actors that is going to modify the geopolitics of the 21st Century. (UNESCO, 2005)

The same apprehension is described in the reports that talking about the future of the discipline of Social Sciences, where the fear to the increasing of knowledge divides within this discipline is pronounced. The same subtitle of the report (knowledge divides) indicates that there

are a special emphasis and concern in the different gaps that are opening in geographic, production, investment and application level, connected with Social Sciences. (UNESCO, 2010a)

These differences are described in the last report about Science of the UNESCO denominated “Science Report 2010”, where with the use of S&T dimensions and R&D indicators contribute with a wide and clear explanation about the knowledge divide among nations and regions. The report also confirmed the real interest of main countries and others non-state actors to invest on Science and Technology as future resources of economic development and geopolitical power. (UNESCO, 2010b)

In the last years, one of the main landmarks about the role of Scientific Knowledge has been the World Conference on Science that was held in Budapest in July of 1999, and was sponsored by the UNESCO. In this context was presented the Declaration on Science and the use of Scientific Knowledge which underscores the political commitment to the scientific endeavor and to the solution of problems at the interface between science and society. The result of this conference was institutionalizing the World Forum that is convening every two years in Budapest in order to debate about the evolution on the world science. The last forum event on 2011, closed the session with a strong declaration called “World Science Forum 2011: New era of global science”. The resume of this statement is very clear about the future of Scientific Knowledge: More than ever before, the world will be shaped by science; new context with fundamental changes in the landscape of science; new era for science with political, economic and social implication; new role for the scientific knowledge to face the grand challenges of the new century; new international actors participating in research and production activities of knowledge; the intensification of relation of cooperation and competence for the scientific knowledge; and finally, the ethical and moral implication of all these impacts and consequences.

Inside these new theoretical perspectives it is important to mention the labor of European Union that has been one of the main actors who wanted to understand the new role of scientific knowledge and try to adapt to it. There are many investigation works and political statement that looking for answers about the real importance of knowledge for the future European organization. Between this works the Lund Declaration its quite remarkable (2009), because it was the start point of the new strategy of European policy on Research and Development. The statement pretend to orient the European scientific development in order to find solutions to the great challenges of the 21st Century, by considering the knowledge as the main instrument for it.

Also the European Commission work in a text, titled: “Europe 2020” (2010) where propose new strategies and policies to create growth and development. Inside these recommendations was mentioned the concept of “smart growth” and how the Europe 2020 strategy will boost European Union economic growth by focusing on the knowledge sector: research, innovation and higher education.

The last fundamental text is the report of European Council by Reflection Group on the future of the European Union on 2030, called: “European Project 2030. Challenges and Opportunities” (2010) This report indicates some goals to reach on 2030 and recommend the emphasis on “growth by knowledge”.

At the same time, many researchers and academics investigators with international consideration have working on the topic of the role of Scientific Knowledge trying to contribute with new theoretical perspective and empirical investigations.

Some researchers have looked toward dynamic of operation for the scientific knowledge similar to the economy, conceiving the existence of a dichotomy centre-periphery. At the beginning, the Dependence Theory just mentions one center and one periphery, therefore, considering only developed and developing countries. Nevertheless, the researcher Immanuel Wallerstein extended this perspective with his theory named system-world where is possible to considered several centers and peripheries. Within this point of view, Wallerstein understand that the creation, production and distribution of scientific knowledge will do from the center; meanwhile, the reception and passive acceptance of this knowledge will do in the periphery. (Wallerstein, 2007)

Manuel Castells introduce the theoretical perspective called new connectivity where the notion of connection increases due to the new technology revolution but also growing up the mechanism to control the scientific knowledge. Basically, Castells argue that inside the network of knowledge and the higher education, the central nodes manage the process of production, communication and creation; control the programs and protocols of all the participants; and the most important, have the power to create network or to connect different networks to each other, and organize the cooperation and avoid the competence. (Castells, 2008)

Saskia Sassen investigates the phenomenon of globalization and linkage the knowledge with geostrategic places. For the author, the technological revolution and the expansion of a global economy have contributed to configuring a new geography of centrality and marginality that cut across the old North/South divide. Now, the knowledge is dividing on center or node (cities) that generates more differences between countries and regions, but also inequality inside. (Sassen, 2007)

Following the Sassen influences, Daniel Innerarity show his concern about the future role of the knowledge and the geographic spaces where found it. Innerarity believes that the scientific knowledge is becoming a new central resource to the economic development, but also for a quality democratic regime. He is agreeing with the idea that information is universally accessible but knowledge is connected with a concrete geographical context. For this reason it is necessary to ask for the real distribution of the scientific knowledge, the digital divide, the knowledge divide and the new regionals peripheries. (Innerarity, 2011)

Jan A.GM. Van Dijk, as well, is working to understand the new role of knowledge and the rise of digital and knowledge divide in the last years. In his book named: "The Deeping Divide: Inequality in the Information Society", Van Dijk, argue that the gap between poor and rich countries is not reducing, on the contrary, is widening, indeed, in the richest nations. According to Van Dijk, old and new gaps are deepening the process. (Van Dijk, 2005)

Within the academic field of International Relations there are only a few investigators that are working on the new role of scientific knowledge. Between them, Charles Weiss is maybe one of the principals. Weiss is trying to connect the changes on S&T with the academic discipline of International Relations. He believes that this connection between S&T and International perspective is a relation without enough academic work for the importance that have. For Weiss knowledge and

international relations affected one another in many different ways and the impact of S&T on international affairs are particularly strong. To analyze this relation he creates a theoretical model called “the triangular relationship”. (Weiss, 2005)

5.3 Necessity of a new academic discussion

All the changes generated during the later years on the international system have forced to begin a new academic debate that offers concrete explanations over the new characteristics that is acquiring the new geopolitical and geo-economics structure of the Scientific Knowledge. In spite of its importance the debate is still insufficient to offer satisfactory answers. At the moment, the academic discussion is concentrated in clarifying if we will advance towards scenarios of more cooperation or more conflict in the relations between the different international actors that produce, manage and transmitting of scientific knowledge.

Some decision makers, stakeholders and researchers as Irina Bokova, Director General of UNESCO or Nina Federoff, Science and Technology Adviser to U.S. Secretary of State from 2007 to 2010, point out that the creation of a new international framework where appear new patterns of interdependence which are opening new spaces for cooperation, support and development among international players. Both recommend the use of bilateral and multilateral action, and the relevance of Scientific Diplomacy as a new tool of cooperation among countries, companies and universities. (Federoff, 2009)

On the other hand, some intellectuals as John Beddington, Scientific Adviser in the British Government or David Dickson, Director of SciDev.Net, consider that there is no evidence to believe in a future scenario with more cooperation between actors. They think that the relation between science and international actors of scientific knowledge are still conflictive due to the different interests that persecute each one. The Scientifics try to develop technical and academic progress at worldwide level, meanwhile, countries, companies and private organizations have to defend and promote his own particularly interests. (Dickson, 2009a)

To conclude this brief theoretical review, it can be said that the necessity of new theoretical perspectives and empirical investigations is evident, especially, in order to give better explanations of the new phenomenon of the role of Scientific Knowledge that have appeared in the last years in the international system. The geopolitical and geo-economic structure of the scientific knowledge is definitively changing and is acquiring new characteristics that force the academic world to look for new theoretical approaches and offer serious and scientific answers. In the middle of this complex and changing international framework, it will be relevant to understand the future scenario; in order to explain the new dynamics and characteristics that will have the future of the geopolitical and the geo economic structure; and finally, to know, if the scientific knowledge will become a central tool of the economic and social development at worldwide level or, on the contrary, it will be an instrument that stimulate the inequality and the concentration of the knowledge in the future of the global society.

6. RESEARCH MODEL AND METHODS

6.1 Research process

This doctoral investigation has a long process of configuration and development that began with the final work presented in the Master Program of Migration, Conflict and Social Cohesion at the University of Deusto entitled “Mobility, Conflict and Cohesion in the new geopolitical and geo economic structure”. These are the first bases for the present investigation.

The first step was to determinate the main objective and the reason of the research. The central interest of the author of this investigation is to understand the new role playing by Scientific Knowledge in the new context of the international system after the Cold War. From this general objective results the specific objectives: identify the main international actors involved in the creation, management and transmission of knowledge (states, companies, universities, NGOs); recognizing the new interaction aspects between them; and, finally, explain the main characteristics and configuration of the new international structure of scientific knowledge.

With these objectives on mind, the next step was to find the more appropriate research model approach for this doctoral investigation. During the first year of the doctoral research we worked on a descriptive and explanatory research using quantitative techniques. At the beginning we have used variables, dimensions and indicators of Science and Technology, and particularly, on the area of Research and Development (R&D).

Actually, we are experimenting a new phase of the investigation, more complex, and we have decided to incorporate a Systemic Approach in the development of the research. The reason of this decision is the total coincidence between the results that allowing obtaining the systemic perspective and the objectives that pretend to reach this investigation. This is the key to consider the systemic approach as a very useful and appropriate methodological tool.

At the moment, the research is under process and development. It is possible to look at some preliminary results, but there is still a lot of work to do. This conference will be very important for this research because we expect the contrast of ideas, discussion, debate and contribution of the PhD’s students, experts and professors of the conference. The comments will be absolutely necessary to improve the work, to rethink the main ideas exposed, and to have a deep reflection about the relevance of this special point of view.

6.2 Research Model

According to the research process mentioned above, we have chosen to develop a research model with the following characteristics:

A doctoral investigation inside the area of Social Sciences that pretends to have a multi and interdisciplinary point of view that allow us to use and to combine different disciplines, methods and

techniques in order to study the phenomenon of Scientific Knowledge. Some of these disciplines are Sociology, Economy, Ethic, Philosophy, Geography, Political Science and International Relations.

Complementary with this interdisciplinary approach, the research pretend to focus the investigation in the field of the International Relations as a principal academic discipline, using methods and techniques of this particularly field of study.

Also the research will use a Quantitative and Qualitative models. In the first case, in the quantitative methods, it will be very important the use of dimension and indicators on Science and Technology (S&T). In the second case, the qualitative investigation, will develop a wide and deep review of all the theoretical debates and the empirical investigations that be connected with the phenomenon of Scientific Knowledge.

Finally, we will use the Systemic perspective as analytical model. This approach will allow reaching very concrete answers about the role of scientific knowledge in the system world, but also systemic schemes that give to the investigation global responses over our main questions and objectives.

6.3 Research method applied and data analyzed

The research method applied and the data analyzed will allow us to know the way to reach the general objectives of the investigation. In order to do this, the following research will be divided in four main and methodological parts. Each of them works with different methods and techniques of investigation necessary to make an appropriate approach of the phenomenon.

The first section is the Theoretical Framework where going to develop the qualitative research. This theoretical background includes the more important theoretical debates about the role of scientific knowledge and the study of the new context of the international system after the Cold War. This section will be divided in the following parts:

- New framework in the International System after the Cold War;
- Globalization, Technological Revolution, new Actors and global Agenda;
- The multiples impacts of Scientific Knowledge in the Global Society;
- The new role of the Scientific Knowledge;
- Evolution of the classic debate about the role of Scientific Knowledge;
- New perspectives, approaches and paradigms about the new role of Scientific Knowledge;
- Approaches from different disciplines on Social Sciences (Sociology, Economy, Political Science, International Studies, etc.) and the Interdisciplinary perspective;
- The debate inside the International Relations.

The second part is the description and explanation of the data with the aid of statistics which refers to the use of quantitative methods. In this section we will work with research data, tabulation and process the information. The most important part of the quantitative research methods includes the following methodological definitions:

- Observation Unit: Geopolitical and geo economic structure of Scientific Knowledge.
- Analysis Unit: Governments; Companies; Universities, NGOs.
- Variables: Competence; Inequality; Concentration; Stratification; Ranking; Polarity.

For every single academic investigation is fundamental to manage, very carefully, the use of data and information. The sources must be reliable and trustworthy. In this case, and after having studied different sources, we decided to use two main databases:

- Organization for Economic Cooperation and Development. (OECD, 2011a, 2011b)
- United Nations for Educational, Science and Culture Organization. (UNESCO, 2010b)

The next section is the Systemic Analysis where we will look for apply the Systemic perspective to our study objective. With this application we will try to reach a series of global schemes that explain the role of the Scientific Knowledge in the international system from the Systemic perspective. Considering the most important techniques used in the General System Theory it has been decided to work with the Black Box and White Box models. The first schemes, called Black Box model, try to explain the global configuration of the international system, describing the elements of the system; the interaction between different subsystems; and particularly, the connection between the International system and the Science and Technology Subsystem (place where produce, transmit and manage the scientific knowledge). The second systemic scheme, is called White Box model, and pretends to analyze the internal operation of the Science and Technology Subsystem to describe the main variables and dimension and the probable causal relations.

The fourth and last part is the closing analyze, that links the theoretical part, the data analyzed and the systemic schemes, trying to get a final conclusion in order to respond the initial questions and satisfy the objectives of the investigation.

7. PRELIMINARY RESEARCH RESULTS

In the context of INTERACT-UNI EU-SPRI Conference at University of Twente, the author pretends to show the first part of his doctoral investigation, the actually research process and the presentation of the preliminary results of this phase of the investigation. A general description of the main initial results could be the followings:

- A brief theoretical systematization of the role of Scientific Knowledge;
- The use of Science and Technology dimensions and indicators as a new approach on Social Science and, especially, in the field of International Relations;
- The use of Systemic Method to analyze the role of scientific knowledge in the international system;
- The explanation of the behavior and the interaction of the principal actors in this new international scenario;
- A first approximation to the main characteristics of the new geopolitical and geo economic structure of scientific knowledge;
- A global and systemic description of the new role of scientific knowledge in the world system.

This first phase of the research could present the preliminary results of the investigation that involve some description and analyze about the behavior of the principal international actor on S&T, especially, the expenditure on Research and Development (R&D) and R&D on Researcher and Personnel.

At the same time, it will be possible to present some global schemes with the application of the General System Theory to explain the role of knowledge in the international system.

7.1 Global analytic description

The use of some tables, graphics and databases with significant information can proof the real relevance of Science and Technology (S&T) indicators for the present investigation. We can explain and understand the behaviors and purposes of states and others non-states actors working with these indicators. The work with research data, the subsequent tabulation and processing the information allow us to reach some interesting preliminary conclusions:

- All the S&T indicators used in the research connected with R&D shows a global increase of the Gross Expenditure on R&D and R&D on Researcher. The world average is an extraordinary 45% in the last 5 years (2002-2007)
- In contrast and, at the same time, this global increase of the indicators on R&D, also show alarming disparity and differences between the international actors. For example, China and India spend on S&T over 140% more in 5 years, but France and United Kingdom only 20% in the same period, and worst, some African and South American countries increases only 0,1%.
- The traditional actors on S&T, named TRIADA of Knowledge (United States, European Union and Japan) also increase in the expenditure on R&D but under the world average: Japan (35%), USA (34%), and EU (28%)
- A really interesting finding is the growth of the well-known as new global challengers. We are talking about countries like China, India or Brazil. All these nations are working very strong to

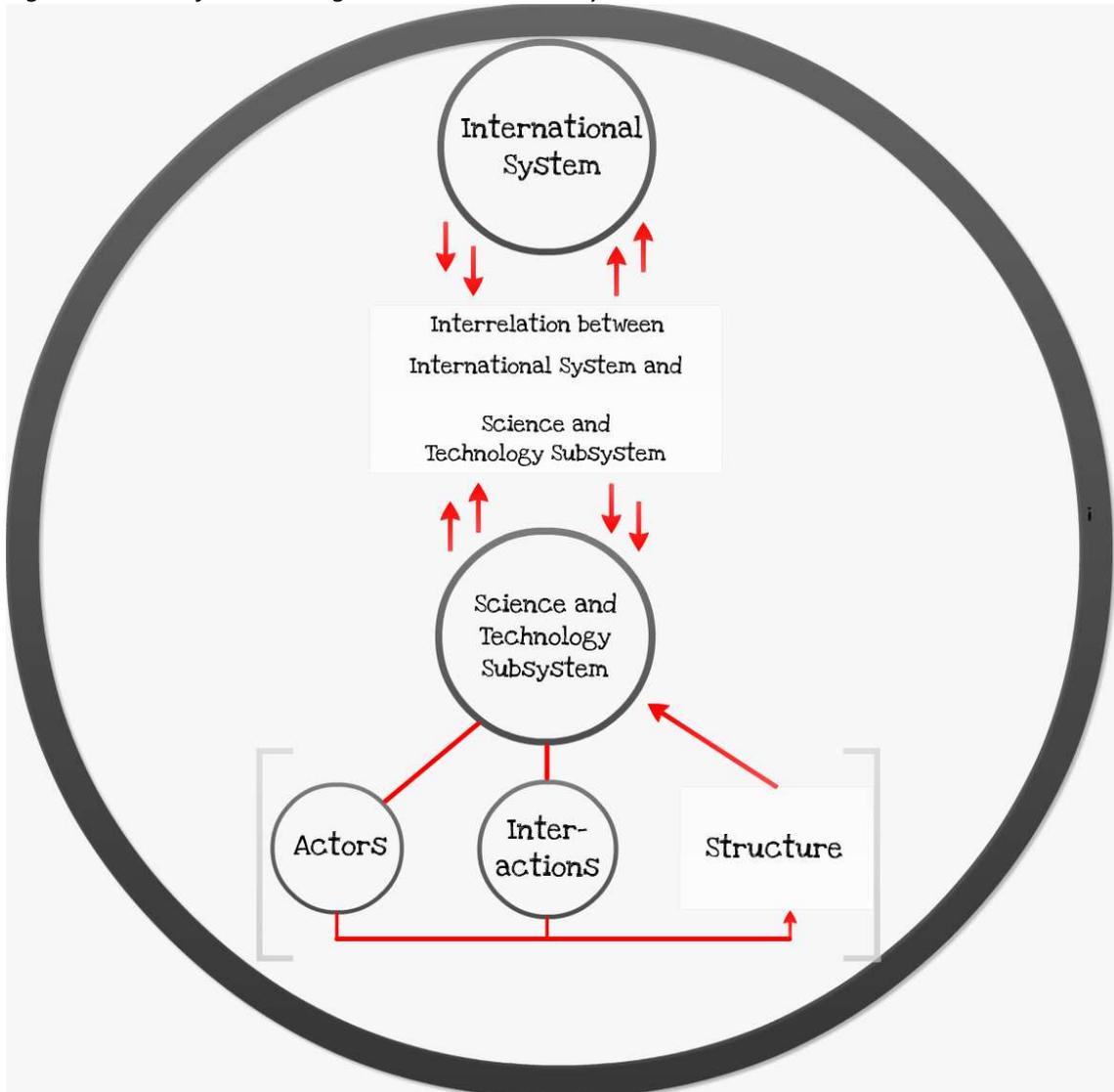
reach the classical TRIADA and they are spending on S&T more than any other countries. In the last years, the growth of this challenger was incredible: China (161%), India (92%), South Africa (91%), Brazil (55%) and Russia (50%).

- The use of indicators on S&T allows us to discover the unequal growing up on inputs for scientific knowledge in the last years. The 50 poorest countries invest only 0,1% of Gross Domestic Product on R&D, meanwhile, the developed countries are near to the 2% and the developing countries between 1% and 1,5%. The gap is growing up.
- It is easy to observe the clear stratification and segmentation that the geopolitical and geo economic structure of scientific knowledge is acquiring. Basically on 3 different levels: The develop countries, the developing countries, and poor countries.
- Some developing countries like China, Brazil, South Africa, South Korea or India, are making a big effort to reduce the gap with the classic actors of scientific knowledge with success. That permits to understand the idea of a scientific knowledge, more decentralized on the future and, maybe, with a more multipolar structure.
- We also found big differences between geographical regions. North America and Europe they still represent the majority of the expenditure on R&D at global level, but in the last ten years, Asia has been growing to reach the same level of North America and Europe. On the other hand, in South America, Africa and the less develop countries of Asia are spending less money on S&T and becoming the gap and the knowledge divide deeper and wider.
- At the same way, we found a strong gap at intra-regional level. In the American continent, the difference between North America and South America (USA and Canada represent 90% of all the invest on R&D in the continent); in Europe between European countries and the rest of the continent but also inside the Union (European Union represent the 85% of the total spend on R&D and the 70% on the stock of Researcher); In Africa between South Africa and the rest of the countries; and finally, in Asia, among China and Japan (both represents the 2/3 of the total invest on S&T in the continent) with the rest of the Asian nation.
- Finally, the relevance of the global expenditure on R&D but especially on Researchers (we must forget that they create and build the scientific knowledge). The spending only on Researchers has increase more than 20% in the last 5 years. All the nations are making strong efforts to keep the national researchers and to become attractive for the foreign academics. The spending on Researchers is one of the key of the Scientific Knowledge.

7.2 System Theory applications

The next step on the investigation is to work in the application of the General System Theory models in connection with the role of the Scientific Knowledge in the international system. To do this it has been created and elaborated four systemic schemes:

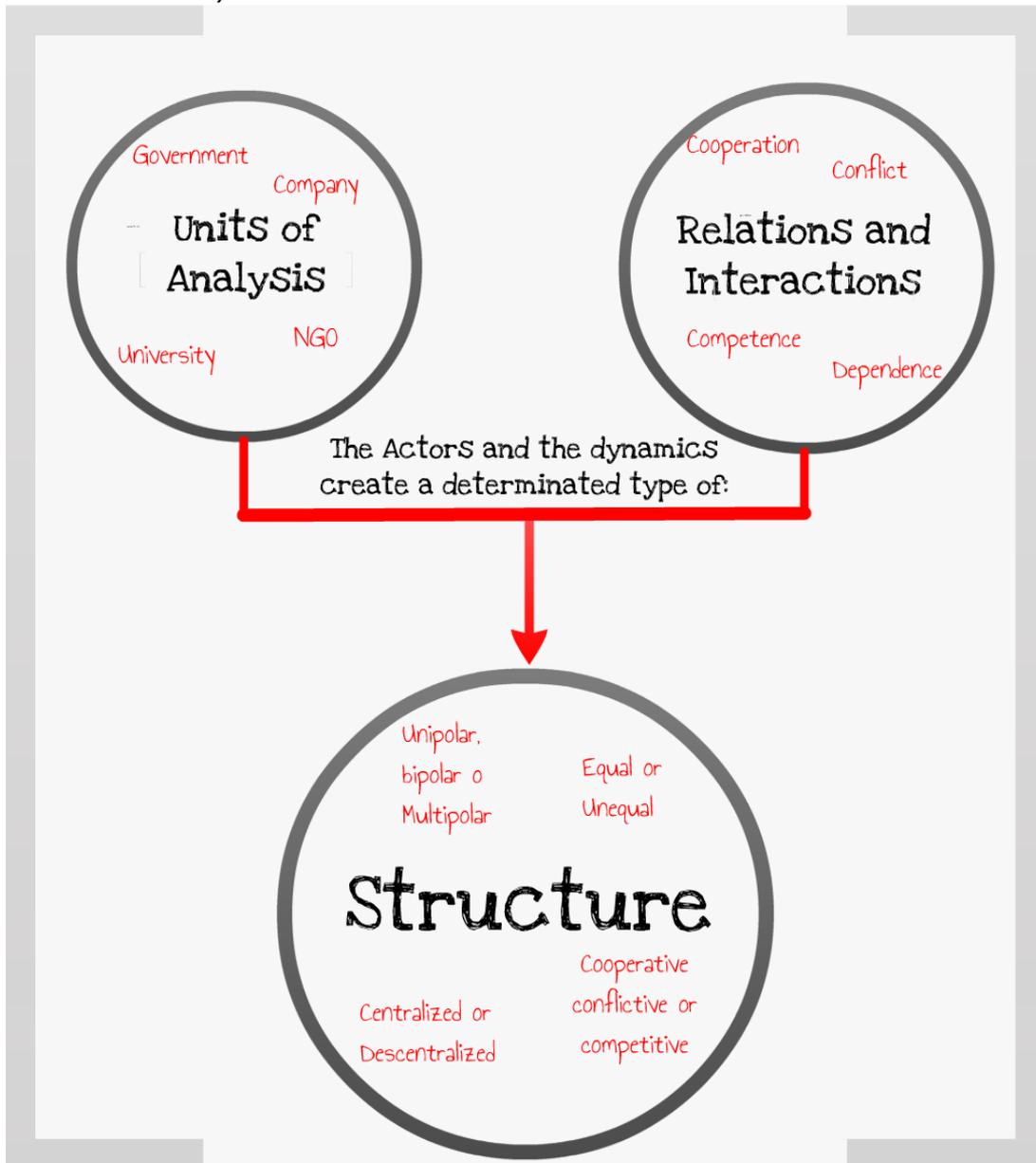
Figure 1: Scientific Knowledge and International System



Source: Elaborated by the author

The Figure 1 shows the global configuration of the role of the Scientific Knowledge in the International System from a Systemic perspective. It is possible to observe the interaction between the International System (composed by many subsystems) with the Science and Technology Subsystem (place where produce, transmit and manage the scientific knowledge). The International System contains and condition the S&T Subsystem but also, and at the same time, will be conditioned with the internal dynamic of the S&T Subsystem.

Figure 2: Elements and objectives of the investigation about the Role of the Scientific Knowledge in the International System



Source: Elaborated by the author

The Figure 2 shows the different elements and the dynamics inside the S&T Subsystem. This configuration is very important for the investigation, because describe the main objectives that pretend to reach the research: The Units of Analysis that participated in the S&T Subsystem (Governments, Companies, Universities and NGOs); the Relation and Interaction between the international actors (Cooperation, Conflict, Competence and Dependence); and finally, the type of Structure of the Scientific Knowledge that is created inside the S&T Subsystem (Unipolar, bipolar o multipolar; Equal or unequal; Centralized or decentralized; and Cooperative, conflictive or competitive).

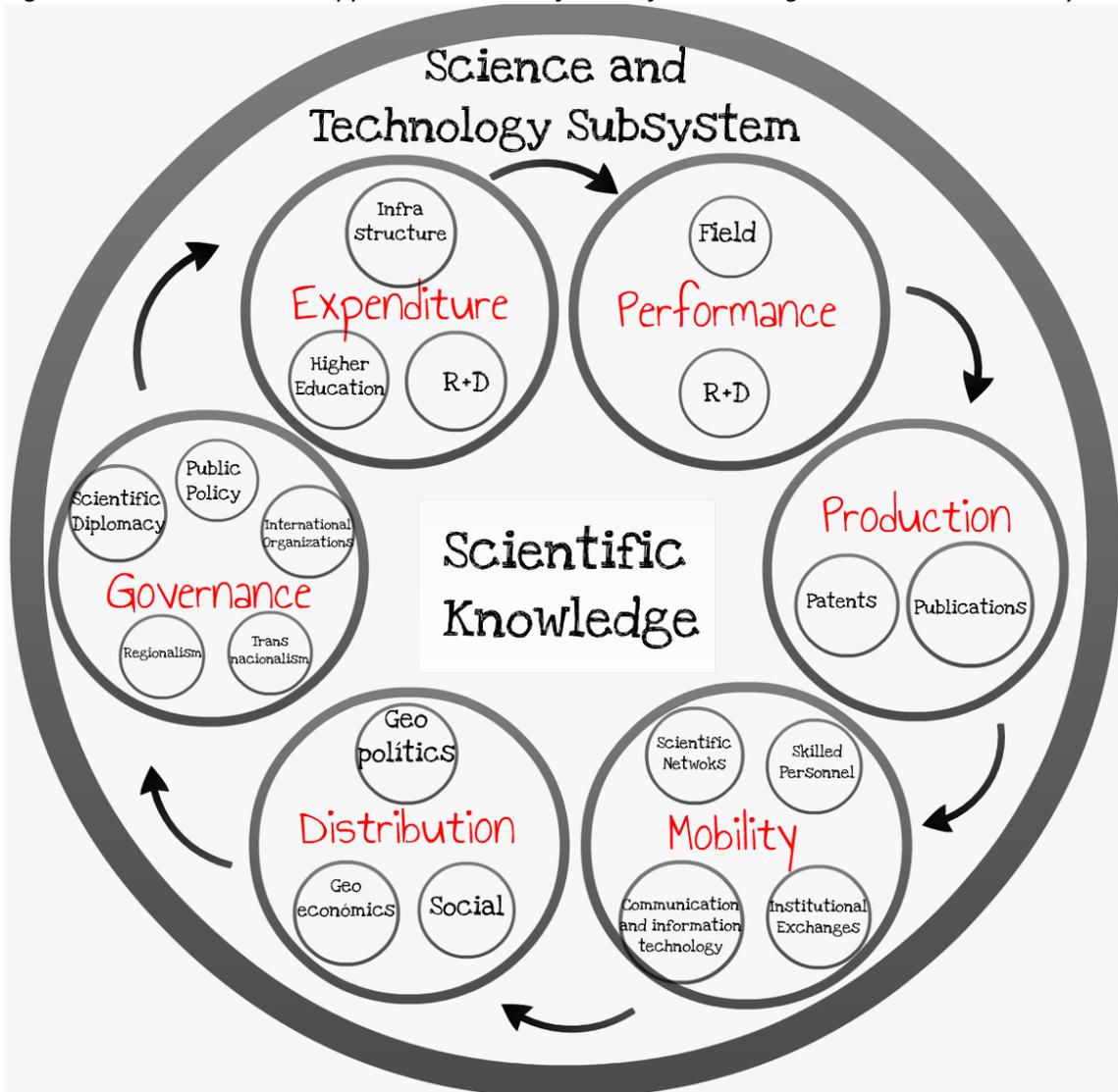
Figure 3: Black Box Model applied to the role of Scientific Knowledge in the International System



Source: Elaborated by the author

The Figure 3 is the application of the Black Box Model to the role of the Scientific Knowledge in the International System. It is possible to understand this scheme as a global overview of the interaction between all the subsystems that integrated the International System with the Science and Technology SubSystem. The importance of this applied model is to permit and to explain the global configuration of the international system, describing the elements of the system; the interaction between different subsystems each other; and particularly, the connection between the International System (with any subsystem) and the Science and Technology SubSystem (place where produce, transmit and manage the scientific knowledge) with the different topics that linking each other.

Figure 4: White Box Model applied to the role of Scientific Knowledge in the International System



Source: Elaborated by the author

Finally, the Figure 4 is the White Box Model applied to the role of Scientific Knowledge in the International System. On the contrary to the Black Box Model, in this case, the real important is understand what happen inside the S&T Subsystem not the linkage with the rest of the subsystem. Generally, this scheme pretends to analyze the internal operation of the Science and Technology Subsystem to describe the main variables and dimension (Expenditure, Performance, Production, Mobility, Distribution and Governance) and the potential causal relations.

8. EXPECTED RESEARCH RESULTS

Besides the preliminary results that have been presented and exposed in this academic paper, the author expects to discover, once finished the investigation, the following research results:

- New description and explanation on the field of Social Science and International Relations about the role of the Scientific Knowledge with the use of Science and Technology variables, dimensions and indicators.
- A Systemic perspective explanation of the role of the Scientific Knowledge in the International System with the use of systemic and global schemes.
- Geopolitical and Geo economic description of the role of the Scientific Knowledge in the World System;
- Analyses of the behavior and linkage of different international actors (government, industry, university and NGOs)
- A global description of the main characteristics of the structure of Scientific Knowledge (unipolar, bipolar, multipolar; equal or unequal; cooperative, conflictive or competitive)

9. RELEVANCE OF RESEARCH

The author has a strong commitment with this research because he believe in the necessity of this kind of academic works. The world order after the Cold War is a new transitional scenario that needs new approaches and perspective to be studied. The academic debate should be principally focus in clarify and analyze if we are moving towards a situation of more cooperation, more competition or more conflict between the different international actors, administrators and transmitters of scientific knowledge and how will be manage this new international framework.

9.1 *Theoretical relevance*

The theoretical relevance of the research topic could be divided in four aspects: a theoretical systematization about the role of Scientific Knowledge in the new world system; a new approach from Social Sciences and International Studies (as a field of study) with the use of Science and Technology indicators; an analysis and explanation of the impact in Social Science and in the International Relation of the changes happened in Science and Technology; and, the use of a Systemic perspective of the new phenomenon of Scientific Knowledge within the international system.

9.2 *Empirical relevance*

Meanwhile, the empirical relevance pretends to include: a geopolitical and a geo economic description and explanation about the role of the Scientific Knowledge; the use of S&T variables, dimensions and indicators to study the behaviors of different international actors; the analysis of the new relations and interactions between the actors of the scientific knowledge (government, industry, university and NGO); and the application of the Systemic perspective to analyze the role of the Scientific Knowledge in the world system.

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